Contract Documents For
Construction Of
Navajo Gallup Water Supply Project
Beacon Bisti N9 Reaches 10.1, 10.2 & 10.3

The Navajo Nation

VOLUME 2
Technical Specifications

August 2025

** See Volume 1 for Contract Documents, Appendices, and Exhibits*

VOLUME 2

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1.2 CONTRACT DESCRIPTION

A. The NGWSP Beacon Bisti N9 (BBN9) Reaches 10.1, 10.2 & 10.3 Project consists of construction of three (3) Reaches of the NGWSP project. The work on the BBN9 Reach 10.1, 10.2 & 10.3 Project as follows:

1. Work of the Reach 10.1 Project includes the installation of approximately 10.8 miles of 16-inch PVC DR18 C-900 waterline, a surge tank, a control valve vault, and two (2) 75,000 gallon water storage tanks.
2. Work of the Reach 10.2 Project includes the installation of approximately 0.8 miles of 16-inch PVC DR14 C-900 waterline, 2.1 miles of 16-inch PVC DR18 C-900 waterline, 5.5 miles of 16-inch PVC DR21 C-900 waterline, a pump station (PP12), a surge tank, a turnout to the Reach 10.2.1 waterline, and two (2) 75,000 gallon water storage tanks.
3. Work of the Reach 10.3 Project includes the installation of approximately 1.46 miles of 16-inch PVC DR14 C-900 waterline, 1.09 miles of 16-inch PVC DR18 C-900 waterline, 4.85 miles of 16-inch PVC DR21 C-900 waterline, a pump station (PP13), a surge tank, a chlorinator, and two (2) 75,000 gallon water storage tanks.
4. PVC waterline includes a combination of bell-and-spigot and fusible joints.

B. Perform Work of Contract on a unit cost basis with Owner in accordance with Conditions of Contract.

1.3 SPECIAL CONSIDERATIONS

A. Contractor shall abide by all permit stipulations and requirements, including but not necessarily limited to Bureau of Indian Affairs (BIA) and Navajo Nation environmental

and archaeological stipulations, utility pipeline encroachment agreements, McKinley County, and BIA-NRO Department of Transportation road crossing permits, regardless of whether such permits are obtained by the Owner, Engineer or Contractor.

1. Navajo Nation's environmental and cultural stipulations for the pipeline is provided in Appendix C. Encroachment agreements and road permits, if obtained by the Owner or Engineer, are provided in Exhibit D.
2. Please note, it is anticipated that an NTUA encroachment agreement will be required to cross existing utilities. Contractor shall not construct within NTUA right of way until NTUA encroachment agreements have been obtained.
3. Contractor shall comply with all of these stipulations, terms and conditions. Said compliance shall be considered incidental to the cost of the project.

B. It is the Contractor's responsibility to apply for and obtain all permits required for the Work that have not already been obtained by the Owner or Engineer. No additional compensation will be provided for obtaining permits and all costs will be considered incidental to the Project. It is anticipated the Contractor will need to obtain, at a minimum, a Low Threat General Permit from U.S. EPA for pipeline flushing. Contractor is wholly responsible to determine what additional permits may be required.

C. If obtained, correspondence from the power line company are included in Exhibit D to the Contract Documents. Contractor is responsible for compliance, including notifying Owner, Engineer and utility companies prior to crossings. Contractor shall adhere to all requirements of the electrical power line crossing permits, if required, and any special notes provided in design drawings, including notification requirements.

D. Cultural Resources Requirements:

1. Contractor must be familiar with and abide by the cultural resource stipulations included in Appendix C of the Contract Documents.
2. Contractor must allow archaeologist and/or Owner's representative to have access to the project site for examination of cultural resources. Contractor must allow archaeologist and/or Owner's representative to halt work, as necessary, to examine cultural resources in spoils and/or trenches. Contractor may move equipment to another location while archaeologist completes his/ her examination of cultural resources. Contractor shall not request additional compensation for any delays caused by archaeological examinations. However, such delays may be considered excused delays and not count toward Contractor's deadline for substantial completion, provided Contractor requests additional time within one (1) week of the delay.
3. Contractor is advised of the presence of designated "Culturally Sensitive Areas" in the project area, which are indicated on the Drawings. Contractor shall notify the Engineer at least 5 working days prior to any ground disturbing activity within 100 feet of any restricted area as designated on the Drawings to allow time for flagging to be erected and/or a permitted archaeological monitor to be scheduled on-site. Ground disturbing activities include equipment mobilization/ storage, vehicular traffic and vegetation removal. The archaeological flagging and monitoring will be provided by the Owner at no cost to the Contractor. Note that temporary construction easements are truncated near these areas and the Contractor shall not encroach beyond established easements. No work shall be performed within 100 feet of any restricted area or truncated TCE unless barricades and/or flags are up.

a. Sites indicated on the Drawings as requiring flagging will require temporary flagging to be installed prior to any ground disturbing activities. The flagging will be installed by the Owner's archaeologist and/or surveyor and must remain in place during the life of the project. No vehicular traffic, personnel or construction activities shall be allowed past the flagging.
    1) After flagging has been installed, the Contractor is responsible for erecting orange construction fencing along ROW.

b. In addition to the flagging, certain sites indicated on the Drawings will also require archaeological monitoring. Contractor shall not perform any ground disturbing activities within 100 ft of these areas at any time without the Owner's archaeologist physically present at the site.

c. Other culturally sensitive areas noted on the Drawings do not require archaeological monitoring or barricades; nonetheless, the Contractor shall avoid construction activities or vehicular traffic through these sites.

4. Archaeological Discovery in the Presence or Absence of Archaeological Monitoring: During surface-disturbance actions if any previously unidentified historic or prehistoric cultural resources are discovered, then all work within 100 feet of the discovery will be suspended and the discovery promptly reported to the Engineer and the Bureau of Reclamation. The Bureau of Reclamation will initiate consultation on the discovery if appropriate. If the discovery is evaluated as being significant, treatment of the discovery may be required prior to allowing the project to proceed. Further damage to significant cultural resources will not be allowed until any required treatment is completed. Work cannot proceed until notice is received from the Bureau of Reclamation.

E. Biological Resources Requirements:

1. The Owner will provide, at no cost to the Contractor, a qualified wildlife biologist to conduct pre-construction survey(s) for raptor nest(s). Raptor nesting season occurs between January 15 to August 15.

    a. If any nests are observed, all NNHP species specific avoidance measures should be followed.

    b. Power pole installations should incorporate Avian Protection Plan guidelines to protect raptors from being electrocuted.

2. The Owner will provide, at no cost to the Contractor, a qualified wildlife biologist to conduct pre-construction survey(s) for migratory bird nests if work is to be performed during the active bird breeding season between March 1 and August 15.

    a. In the event an active bird nest or species habitat is discovered, the Owner's wildlife biologist will flag the required buffer zone around the nest. The buffer zone is typically a 165 ft radius around the nest. This buffer zone will not be barricaded by the Owner's surveyor.

    b. The Owner's wildlife biologist will monitor the nest and notify the Contractor when work may commence within the buffer zone.

    c. The Contractor shall not encroach within the flagged buffer zone until notified by the Owner's wildlife biologist.

3. The Contractor shall notify the Engineer at least 10 work days prior to commencing ground disturbing activities, and is responsible to coordinate scheduling with the wildlife biologist to perform the pre-construction surveys. Surveys should take place no more than 5 days prior to ground disturbing activities.

4. Revegetation should follow seed mix in the Re-seeding Requirements in Appendix C. Site specific revegetation plans should be developed prior to vegetation being removed in ROW. If after 3 years, revegetation is not successful, the area may need to be fenced to limit livestock use of the area.

F. At all wash crossings, the contractor will adhere to all Clean Water Act Section 404 General Conditions, Regional Conditions, and Conditional Section 401 Certification for all approved Nationwide Permits, as well as any Special Conditions that may be determined by the U.S. Army Corps of Engineers (refer to URL given below for each document pertaining to the relevant Nationwide Permit process).

1. 2012 Nationwide Permits, Conditions, District Engineer's Decision, Further Information, and Definitions (with corrections):
https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll7/id/6770 (page 1, pages 7 through 9 [up to but not including paragraph 14], page 28 [starting at C. Nationwide Permit General Conditions] through page 46)

2. 2012 Regional Conditions in New Mexico
http://www.spa.usace.army.mil/Portals/16/docs/civilworks/regulatory/Regional%20Conditions/NM%20regional%20conditions%20FINAL.pdf
(pages 1 through 2)

3. NMED conditional Water Quality Certification for Nationwide Permits
http://www.spa.usace.army.mil/Portals/16/docs/civilworks/regulatory/Water%20Quality%20Certification/404%20NWP%20Final%20Certs.pdf
(all pages)

G. Storm Water Pollution Prevention Plan (SWPPP): Contractor shall be wholly responsible for the preparation and implementation of the SWPPP, and any erosion / sediment practices described therein. Such implementation shall include, but not necessarily be limited to, obtaining any required National Pollution Discharge Elimination System (NPDES) permit(s) and submitting the contractor's Notice of Intent (NOI) to competent agencies prior to construction, implementation and maintenance of all Best Management Practices (BMPs) specified in the SWPPP, inspection of entire project site as specified in the SWPPP, maintaining and providing all documentation required in the SWPPP (including keeping up-to-date project maps and as-builts before, during and after construction), filing of a Notice of Termination (NOT) upon completion of the project and removal of BMPs upon the required time interval after completion of the project.

H. No reports or drawings relating to Hazardous Environmental Conditions at the site are known to the Owner.

I. Exhibit A to the Contract Documents contains geotechnical reports which include in-situ soil moisture measurements, and Standard Proctor test results (including optimal moisture content) from test holes at various locations within the project area. Contractor is advised that test holes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. Contractor is wholly responsible for any assumptions made about sub-surface conditions between the test holes. Moreover, in-situ moisture content varies with time, and the Owner makes no representation that the in-situ moisture

at the time the measurements were taken will be the same at the time of construction. The results of the Proctor and in-site moisture tests are provided for Contractor's convenience only; they are not considered "Technical Data", as defined in Article 5.03 of the General Conditions, upon which the Contractor is entitled to base his/ her bid.

1. The Contractor is entitled, however, to rely upon the soil bearing capacity and other geotechnical design criteria for the pump station, surge tank building, water storage tank and chlorinator foundations. Moreover, the Contractor shall be required to follow the recommendations of the geotechnical report for building & tank foundation design, sub-foundation, and over excavation.

J. Contractor is advised that if there is subsurface rock present requiring specialized equipment to remove, as defined in Section 31 23 18 - Rock Removal, Contractor shall notify Engineer prior to commencement of rock removal work each time such rock is encountered, and await approval from Engineer before proceeding. Furthermore, the Contractor and Engineer must agree on rock quantity at the end of each work day, and both parties must sign off on the quantity of rock in the corresponding Engineer's Resident Project Representative (RPR) daily field report, and Contractor will be compensated for such work per Article 1.2.A of Section 31 23 18, which establishes the basis of measurement and payment for trench rock removal.

1. Data in Exhibit B - Soil and Rock Potholing Information identifies the results of the 'potholing' that was performed at various locations along the waterline alignment. Contractor is advised that test potholes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. The results of the potholing are provided for Contractor's convenience only; they are not considered "Technical Data", as defined in Article 5.03 of the General Conditions, upon which the Contractor is entitled to base his/ her bid. Contractor shall not make any claims due to differing sub-surface conditions based on the information provided in Exhibit C.

2. Excavated rock may be disposed of within the ROW as long as the conditions stipulated in Section 31 23 17 – Trenching, Article 3.8, are met.

K. Contractor is solely responsible for providing all water for the construction of the project and no guarantees are made by the Owner or Engineer as to the availability of any particular water sources. All costs associated with purchase, permits, hauling, etc. for construction water shall be considered incidental.

L. The contractor is advised that a Water Import Permit is required for any construction water brought onto the Navajo Nation. The water import permit can be acquired from the Navajo Nation Water Code Administration. The import permit fee is a one-time fee.

M. Contractor must coordinate use of potable water, such as for filling and flushing the pipeline, with Bureau of Reclamation, NTUA and Engineer at least two (2) weeks prior to using water. Contractor must provide Reclamation, NTUA and Engineer with key information, such as desired maximum instantaneous flow rate (gpm), desired maximum daily flow rate (gpd), desired schedule of water use, and other information as required by Reclamation and NTUA.

N. Contractor must not infringe on NTUA's ability to serve its existing customers by excessive water use. NTUA water shall not be used for compaction, dust abatement or similar activities without express written permission by NTUA. Note that NTUA and/or

Engineer may limit the maximum allowable instantaneous flow rate, daily flow rate, water usage days, etc. NTUA will not charge for water going into the pipeline.

1. Actual flow rate of NTUA water available for line filling and flushing may be significantly less than the maximum allowable flow rate specified in the Technical Specifications. Contractor shall allow adequate time in construction schedule to fill and flush the pipeline given the amount of water available at the time of construction, and shall not request additional compensation due to water shortages for filling and flushing the pipeline.

O. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water. Contact Water Code Administration for more information.

P. Contractor may use the flush valves designed in the proposed pipeline, as well as tank floor drains, to flush water out of the system. Flushed water may be disposed of in the natural waterways adjacent to the flush valves and drains, provided the rate of flushing does not damage the surrounding environment (i.e. by flooding, erosion, etc.). Do not flush water from designated flush valves prior to installing riprap at the flush valve outlets. Water chlorinated to levels above those normally associated with drinking water shall be neutralized prior to discharge.

1. Contractor shall obtain a Low Threat General Permit from U.S. EPA, as required, and shall abide by all stipulations of said permits.

Q. No dedicated borrow area for fill material has been pre-determined for this project. Material may be borrowed from within the designated ROW, provided all conditions set forth in the specifications are met

R. Contractor is advised that compaction requirements shall be strictly enforced. In the event that the contractor is unable to meet compaction requirements for pipe embedment using select material, the Contractor shall have the option to use soil cement at no additional cost to the Owner.

1. Please note all FPVC pipe requires the pipe embedment be compacted to a minimum of 90% .

S. Contractor is advised that the trench widths shown in the Drawings are minimum widths only. In the event that the Contractor is unable to meet pipe embedment and compaction specifications using the minimum trench width and needs to increase trench width in order to meet these specifications, such increase in trench width shall be provided at no additional cost to the Owner.

T. Contractor is advised that pipeline line and grade specifications will be strictly enforced. See Section 33 11 13 of the Technical Specifications for horizontal and vertical pipeline and grade.

U. Contractor is advised that a 40’ wide permanent right-of-way easement is established along the proposed pipeline alignment, 20’ to each side of the centerline. An additional 30’ of temporary construction easement (TCE) is provided on each side of this permanent easement, resulting in a total of 100’ wide corridor to which the Contractor must limit all construction activities.

1. Contractor is advised that at certain locations the temporary construction easement is truncated on one side or the other to avoid encroaching on culturally sensitive areas

or adjacent properties. These areas are indicated on the Drawings and will be staked by the Owner's Surveyor. Contractor shall not encroach beyond the established work space in these areas.

2. Temporary construction easement is for temporary construction activities only. All pipe, valves and other appurtenances must remain within the permanent right-of-way.

3. Contractor is permitted to use any area within the approved right-of-way and temporary construction easement for staging and storage, including the tank site, provided such use does not disturb other land users or areas outside the ROW and TCE and that the staging areas are restored to their original condition prior to final completion.

    a. Contractor is wholly responsible for location, set-up, security, and any required temporary utilities associated with staging and storage areas.

    b. All staging and storage areas within the project area must be approved in advance by the Owner.

4. All areas disturbed during construction shall be reclaimed in accordance with the Contract Documents, regardless of whether they are part of the permanent ROW or TCE.

V. At fence crossings, where the contractor removes a wire fence, the contractor shall restore fences to original condition or better, and shall install 10-ft wide lockable 'rancher-style' gates with H-braces on both sides within pipeline right-of-way at all fence crossings. Each post shall be embedded in 3,000 psi concrete. Attach wire to the H-braces prior to cutting the fence to prevent slacking of wire. Contract shall repair all gates and fences in a timely manner to prevent livestock ingress / egress.

W. Restore all open-cut driving surfaces, including parking lots, roads and driveways, to original condition or better, including replacement of base course, gravel or pavement as needed. Dirt roads and driveways shall be restored with compacted backfill as indicated in the drawings and specifications, plus surface material as specified. All restoration work for which no bid item is given shall be considered incidental.

X. Contractor is responsible for providing schedule and plans with locations for lane and shoulder closures, if any, to the Engineer, McKinley County and BIA-NRO Department of Transportation prior to starting work. Contractor shall obtain any required supplemental permits from the relevant agencies.

Y. Excess dirt from cutting may be disposed of on-site, provided the finished grade and compaction meet specifications and are approved by the Engineer.

Z. For the present Project, Bidding Documents in electronic media format are furnished to bidding contractors for the sole purpose of preparing bids, and not for construction. The selected construction Contractor shall not rely on files provided in electronic media format for construction but rather hard copies of such data provided by the Engineer or Owner upon award of the Contract.

AA. Prior to beginning construction activities, the Contractor will furnish pre-construction full-coverage photo or video documentation of the entire construction site per requirements set forth in Article 3.2.A of Section 33 11 13 of the Technical Specifications.

BB. Drawings in CAD format related to earthwork required at the sites are available from Souder, Miller & Associates at www.soudermiller.com. Any Bidder interested in obtaining

access to the files must complete an 'Electronic Data File Transfer and Sharing Agreement' and submit to the office of the Engineer, Souder, Miller and Associates, attention Wacey Jodie, Project Manager Assistant, at wacey.jodie@soudermiller.com. Upon submittal of the attached form, the Bidder will receive instructions on how to access the files.

CC. Upon request, CAD files for the plan and profile sheets will be made available to the winning Contractor after Notice of Award. However, neither the Owner nor Engineer shall assume any liability for their use, nor shall use of any electronic files relieve the Contractor of his/her responsibility to meet the conditions of the Contract Documents, including the published Drawings. Contractor must submit an Electronic Data File Transfer and Sharing Agreement to the Engineer prior to receiving CAD files.

DD. In the event that a Navajo Nation Forestry Department (NNFD) tree cutting permit becomes required, any fees directly charged by NNFD may be covered under the testing allowance.

EE. HDPE is not an acceptable substitution for Fusible PVC. The use of HDPE would significantly change the engineered design. Internal restrained joint PVC is not an acceptable substitution for Fusible PVC. Internal restrained joint PVC is not a monolithic / leak free pipe and therefore not an acceptable substitution.

FF. The plan and profile sheets show horizontal angles with DI ell(s) or fusible PVC sweep(s) called out. The contractor is responsible for installing the specified fittings at each location. In addition to the specified fitting(s), use joint deflection to achieve the specified horizontal angle. If a location is shown without specifying a fitting, use joint deflection to achieve the horizontal angle.

GG. Contractor shall provide two (2) copies of the safety plan to the Engineer prior to commencing construction (one shall be for Owner's files). Neither the Owner nor Engineer shall approve or comment on the Contractor's safety plan, nor shall the Owner or Engineer assume any responsibility for assuring compliance on the part of personnel on site, other than Owner's or Engineer's employees and representatives, as stipulated in Paragraph 7.12.D of the Standard General Conditions and Navajo Nation Supplemental Conditions (EJCDC C-700 NN).

HH. Recipients of an award of Federal financial assistance from a program for infrastructure are hereby notified that none of the funds provided under this award may be used for an infrastructure project unless:

1. All iron and steel used in the project are produced in the United States—this means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States;

2. All manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard that meets or exceeds this standard has been established under applicable law or regulation for determining the minimum amount of domestic content of the manufactured product; and

3. All construction materials are manufactured in the United States—this means that all manufacturing processes for the construction material occurred in the United States. The construction material standards are listed below.

a. *Incorporation into an infrastructure project.* The Buy America Preference only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at or before the completion of the infrastructure project. Nor does a Buy America Preference apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project but are not an integral part of the structure or permanently affixed to the infrastructure project.

b. *Categorization of articles, materials, and supplies.* An article, material, or supply should only be classified into one of the following categories:

i. Iron or steel products.

ii. 15 Manufactured products.

iii. Construction materials.

iv. Section 70917(c) materials.

An article, material, or supply should not be considered to fall into multiple categories. In some cases, an article, material, or supply may not fall under any of the categories listed in this paragraph. The classification of an article, material, or supply as falling into one of the categories listed in this paragraph must be made based on its status at the time it is brought to the work site for incorporation into an infrastructure project. In general, the work site is the location of the infrastructure project at which the iron, steel, manufactured products, and construction materials will be incorporated.

c. *Application of the Buy America Preference by category.* An article, material, or supply incorporated into an infrastructure project must meet the Buy America Preference for only the single category in which it is classified.

d. *Determining the cost of components for manufactured products.* In determining whether the cost of components for manufactured products is greater than 55 percent of the total cost of all components, use the following instructions:

i. For components purchased by the manufacturer, the acquisition cost, including transportation costs to the place of incorporation into the manufactured product (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

ii. For components manufactured by the manufacturer, all costs associated with the manufacture of the component, including transportation costs as described in paragraph above (i), plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the manufactured product.

e. *Construction material standards.* The Buy America Preference applies to the following construction materials incorporated into infrastructure projects. Each construction material is followed by a standard for the material to be considered "produced in the United States." Except as specifically provided, only a single standard should be applied to a single construction material.

i. Non-ferrous metals. All manufacturing processes, from initial smelting or melting through final shaping, coating, and assembly, occurred in the United States.

ii. Plastic and polymer-based products. All manufacturing processes, from initial combination of constituent plastic or polymer-based inputs, or, where applicable, constituent composite materials, until the item is in its final form, occurred in the United States.

iii. Glass. All manufacturing processes, from initial batching and melting of raw materials through annealing, cooling, and cutting, occurred in the United States.

iv. Fiber optic cable (including drop cable). All manufacturing processes, from the initial ribboning (if applicable), through buffering, fiber stranding and jacketing, occurred in the United States. All manufacturing processes also include the standards for glass and optical fiber, but not for non-ferrous metals, plastic and polymer-based products, or any others.

v. Optical fiber. All manufacturing processes, from the initial preform fabrication stage through the completion of the draw, occurred in the United States.

vi. Lumber. All manufacturing processes, from initial debarking through treatment and planing, occurred in the United States.

vii. Drywall. All manufacturing processes, from initial blending of mined or synthetic gypsum plaster and additives through cutting and drying of sandwiched panels, occurred in the United States.

viii. Engineered wood. All manufacturing processes from the initial combination of constituent materials until the wood product is in its final form, occurred in the United States.

4. *Waivers.* When necessary, recipients may apply for, and the agency may grant, a waiver from these requirements. Information on the process for requesting a waiver from these requirements can be found at https://www.doi.gov/grants/buyamerica.

When DOI has determined that one of the following exceptions applies, the awarding official may waive the application of the Buy America Preference in any case in which the agency determines that:

a. applying the Buy America Preference would be inconsistent with the public interest;

b. the types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality; or

c. the inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent.

A request to waive the application of the Buy America Preference must be in writing. The agency will provide instructions on the format, contents, and supporting materials required for any waiver request. Waiver requests are subject to public comment periods of no less

than 15 days and must be reviewed by the Office of Management and Budget (OMB) Made in America Office.

There may be instances where an award qualifies, in whole or in part, for an existing waiver described at the Approved DOI General Applicability Waivers website located at https://www.doi.gov/grants/BuyAmerica/GeneralApplicabilityWaivers.

5. *Definitions*

a. "Buy America Preference" means the "domestic content procurement preference" set forth in section 70914 of the Build America, Buy America Act, which requires the head of each Federal agency to ensure that none of the funds made available for a Federal award for an infrastructure project may be obligated unless all of the iron, steel, manufactured products, and construction materials incorporated into the project are produced in the United States.

b. "Construction materials" means articles, materials, or supplies that consist of only one of the items listed in paragraph (1) of this definition, except as provided in paragraph (2) of this definition. To the extent one of the items listed in paragraph (1) contains as inputs other items listed in paragraph (1), it is nonetheless a construction material.

(1) The listed items are:

(i) Non-ferrous metals;

(ii) Plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables);

(iii) Glass (including optic glass);

(iv) Fiber optic cable (including drop cable);

(v) Optical fiber;

(vi) Lumber;

(vii) Engineered wood; and

(viii) Drywall.

(2) Minor additions of articles, materials, supplies, or binding agents to a construction material do not change the categorization of the construction material.

c. "Infrastructure" means public infrastructure projects in the United States, which includes, at a minimum, the structures, facilities, and equipment for roads, highways, and bridges; public transportation; dams, ports, harbors, and other maritime facilities; intercity passenger and freight railroads; freight and intermodal facilities; airports; water systems, including drinking water and wastewater systems; electrical transmission facilities and systems; utilities; broadband infrastructure; and buildings and real property; and structures, facilities, and equipment that generate, transport, and distribute energy including electric vehicle (EV) charging.

d. "Infrastructure project" means any activity related to the construction, alteration, maintenance, or repair of infrastructure in the United States regardless of whether

infrastructure is the primary purpose of the project. See also paragraphs (c) and (d) of 2 CFR 184.4.

e. “Iron or steel products” means articles, materials, or supplies that consist wholly or predominantly of iron or steel or a combination of both.

f. “Manufactured products” means:

(1) Articles, materials, or supplies that have been:

(i) Processed into a specific form and shape; or

(ii) Combined with other articles, materials, or supplies to create a product with different properties than the individual articles, materials, or supplies.

(2) If an item is classified as an iron or steel product, a construction material, or a Section 70917(c) material under 2 CFR 184.4(e) and the definitions set forth in 2 CFR 184.3, then it is not a manufactured product. However, an article, material, or supply classified as a manufactured product under 2 CFR 184.4(e) and paragraph (1) of this definition may include components that are construction materials, iron or steel products, or Section 70917(c) materials.

g. “Predominantly of iron or steel or a combination of both” means that the cost of the iron and steel content exceeds 50 percent of the total cost of all its components. The cost of iron and steel is the cost of the iron or steel mill products (such as bar, billet, slab, wire, plate, or sheet), castings, or forgings utilized in the manufacture of the product and a good faith estimate of the cost of iron or steel components.

h. “Section 70917(c) materials” means cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives. See Section 70917(c) of the Build America, Buy America Act.

1.4 WORK BY OWNER

A. Owner-provided Archaeologist:

1. The Owner shall provide the services of a qualified archaeologist at no cost to the Contractor. The Owner’s archaeologist will provide site flagging and monitoring at “Culturally Sensitive Areas” as designated on the Drawings. Refer to foregoing section for Contractor’s responsibilities in these areas.

B. Owner-provided Wildlife Biologist:

1. The Owner shall provide the services of a qualified wildlife biologist at no cost to the Contractor. The Owner’s wildlife biologist will perform pre-construction bird nest survey(s), delineate the required avoidance buffer around any discovered nests, and monitor any active nests until the nests are vacated. Refer to foregoing section for Contractor’s responsibilities in these areas.

C. Owner-provided Surveyor:

1. Certain construction survey staking, benchmarks, and as-built surveying services shall be provided by the Owner at no cost to the Contractor.

2. Refer to Section 02 21 13 – Surveying for specific services to be provided by the Owner, exclusions, and responsibilities of the Contractor.

1.5 CONTRACTOR'S USE OF PREMISES

A. No work shall be done before 7:00 A.M. or after 7:00 P.M., local time on a working day, on Sundays, or on legal holidays, except as necessary for the proper care and protection of work already performed, or during emergencies. Any deviations from this specification shall require prior written approval by the Owner.

B. The Contractor shall make every effort to minimize noise caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise.

C. The Contractor shall restrict his operations as nearly as possible to the immediate site. Unnecessary cutting of vegetation adjacent to the site is prohibited. Every effort shall be made to minimize erosion during and after construction and the site shall be returned to its original condition, except where improvements are indicated or required.

D. The Contractor shall take affirmative action to prevent the misuse of the natural environment, wasting of natural resources, or destruction of natural values.

E. The Contractor shall conform to all requirements set forth in the latest edition of the "New Mexico Standard Specifications for Public Works Construction" with latest revision, and "Occupational Safety and Health Administration Regulations" for trenching, shoring and excavation.

1.6 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

B. The Contractor shall furnish all materials, labor, plant and equipment necessary to complete the contract work as called for by the Technical Specifications and as indicated on the Drawings. Material and work, either expressed or implied, necessary for the satisfactory completion of the contract work shall be considered an integral part thereof.

C. All standards incorporated herein by reference shall be the latest edition, unless otherwise specified. The abbreviations and applicable standards are described below:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AIA	American Institute of Architects
ANSI	American National Standards Institute, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CID	Construction Industries Division of the NM Regulation and Licensing Department
EJCDC	Engineers Joint Contract Documents Committee
EPA	Environmental Protection Agency
ISO	International Organization for Standardization
MSJC	Masonry Standards Joint Committee

NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators
NFPA	National Fire Protection Agency
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Department of Environment
NNOLR	Navajo Nation Office of Labor Relations
NTUA	Navajo Tribal Utility Authority
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
SSPC	Society for Protective Coatings
IBC	International Building Code

1.7 MINIMUM WAGE RATE DETERMINATION

A. The Navajo Nation prevailing wage rates will apply to this project. The wage rate determination provided by the Navajo Office of Labor Relations (NOLR) is provided in Appendix B to the Contract Documents. It is wholly the responsibility of the Contractor to inform him/herself of and abide by all regulations and requirements set forth by the NOLR.

B. The Federal Davis-Bacon Act and the New Mexico Public Works Minimum Wage Act do not apply to the present project.

1.8 TESTING AND INSPECTION ALLOWANCES

A. Testing Allowance: The bid schedule includes a predetermined sum to cover the cost of testing and inspection services as required in the Contract Documents.

B. Costs Included in Allowance: Fees charged by testing firm performing the testing, including field and laboratory costs for compaction, concrete, and PVC fusion joint testing only.

C. Costs Not Included in Allowance:

1. Incidental labor and facilities required to assist testing or inspection firm, such as preparation of test pits, surface preparation, provision of safe access for testing personnel, and other work performed by the Contractor to facilitate testing.
2. Work performed by the testing laboratory that is not part of actual testing.
3. Cost of disinfection of waterlines, chlorine tests, or bacteriological tests.
4. Costs of hydrostatic pressure testing or testing of material welds as called for in the Contract Documents.
5. Costs of tank weld testing.
6. Costs of steel piping weld testing.
7. Costs of failed tests as determined by Engineer.
8. Any other tests not specifically authorized in advance by the Engineer.

D. Costs will be drawn from testing allowance and paid based on invoice(s) submitted to Contractor by testing or inspection firm(s).

1.9 SCHEDULE OF VALUES

A. Submit schedule on EJCDC Form C-620, or on other form provided by Engineer. Contractor's standard form or electronic media printout will be considered.

B. Base structure of Schedule of Values on Bid Schedule with identical item numbering, quantities, and values.

C. Submit Schedule of Values at least 15 days prior to first Progress Meeting.

1.10 APPLICATIONS FOR PAYMENT

A. Application for Payment is synonymous with Partial Payment Estimate.

B. Submit copies of each application on the Partial Payment Estimate form provided in the Contract Documents, together with updated Schedule of Values identifying fully the list of items in the Application for Payment.

C. The Application for Payment form shall be submitted to the Engineer and RPR electronically 15 days prior to the monthly progress meeting electronically as an Excel spreadsheet. Submit up-to-date revisions of the following documents every month with Application for Payment. Application for Payment will not be processed without these updated documents.

1. Record Drawings
2. Construction Schedule, including overall project schedule and look-ahead schedule
3. All relevant documentation of testing performed during the pay period, such as concrete testing, compaction testing, weld x-rays, PVC fusion joint testing, holiday and other coating testing, and any other testing specified in the Contract Documents
4. Fusion machine data logs
5. Any Stored Material Invoices

D. Payment Period: Monthly

1.11 CHANGE PROCEDURES

A. All Change Orders shall be prepared on the form provided in these Contract Documents.

B. Unit Price Change Order: For pre-determined unit prices and quantities, Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work not pre-determined, refer to Article 11 - Change of Contract Price; Change of Contract Times, of the Standard General Conditions (EJCDC C-700 NN Standard General Conditions and Navajo Nation Supplemental Conditions of the Construction Contract).

1.12 UNIT PRICES

A. Engineer will take measurements and compute quantities accordingly. The Contractor will assist in taking of measurements and determination of work completed prior to preparation of corresponding Application for Payment.

1.13 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.

B. Coordinate related Work and modify surrounding Work as required.

C. Schedule of Alternates:

1. Reach 10.2 Alternate No. 1: Open Cut Installation at Multiple Utility Crossing at Approximate Sta. 219+00

   a. Alternate Item: Bid Item Numbers 65A and 66A. Drawing Sheet C-8.

2. Reach 10.2 Alternate No. 2: HDD Installation at Multiple Utility Crossing at Approximate Sta. 219+00.

   a. Alternate Item: Bid Item Numbers 65B. Drawing Sheet DT-12.

1.14 COORDINATION

A. Coordinate scheduling, submittals, and Work of various sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

C. Abide by Traffic Control Plan provided by Engineer and coordinate all lane closures and other traffic control activities with relevant agencies, as described above.

D. Contractor shall obtain permits from McKinley County and BIA-NRO Department of Transportation prior to encroaching on any county or BIA roads, except for permits already obtained by the Owner or the Engineer.

1. Contractor shall notify the BIA-NRO Department of Transportation and the Engineer at least five (5) working days prior to working within the ROW of any BIA road.

E. Contractor must coordinate use of potable water, such as for filling and flushing the pipeline, with Bureau of Reclamation and NTUA at least two (2) weeks prior to using water. Contractor must provide Bureau of Reclamation and NTUA with key information, such as maximum instantaneous flow rate (gpm), maximum daily flow rate (gpd), schedule of water use, and other information as required by Bureau of Reclamation and NTUA. Bureau of Reclamation and NTUA will advise Contractor of flow rate available for pipeline filling and flushing.

1. Contractor must not infringe on NTUA's ability to serve its existing customers by excessive water use. Contractor shall limit water use to avoid such infringement.

2. Contractor is advised that actual flow rate of Bureau of Reclamation and NTUA water available for line filling and flushing may be significantly less than the maximum allowable flow rate specified in the Technical Specifications. Contractor shall adjust construction schedule based on actual available flow rate.

F. Bureau of Reclamation and NTUA will not be the owner's RPR for the project; however, Bureau of Reclamation and NTUA will be on the job site periodically to inspect work.

G. All hydrostatic pressure tests must be witnessed by Bureau of Reclamation and NTUA personnel. Contractor is responsible for coordination of testing schedule with Bureau of Reclamation and NTUA to allow representatives to be present.

H. Contractor must also notify Bureau of Reclamation at least two (2) weeks prior to connecting to any Bureau of Reclamation water facility or working within a Bureau of Reclamation Right of Way (ROW).

1. Contractor shall coordinate all activities with Bureau of Reclamation and must receive Bureau of Reclamation approval prior to connecting to any Bureau of Reclamation facility.

I. Contractor must also notify NTUA at least two (2) weeks prior to tapping any existing NTUA water facility or crossing existing NTUA waterlines with proposed waterlines. Connections to existing tanks shall be floor penetrations.

1. Contractor shall coordinate all tapping activities with NTUA and must receive NTUA approval prior to tapping any NTUA facility.

2. Contractor may be required to provide temporary tanks to maintain water service to NTUA's existing customers while tapping tanks. Such temporary tanks, if required, shall be provided at no additional cost to the Owner.

J. Contractor is responsible for coordination with Bureau of Reclamation of final project inspection by Bureau of Reclamation personnel. Bureau of Reclamation typically requires 21 days notice prior to final inspection.

K. Contractor is responsible for coordination with NTUA of final project inspection by NTUA personnel prior to NTUA acceptance and the issuance of the Affidavit of Punch List Completion of project to NTUA. NTUA typically requires 21 days notice prior to final inspection. NTUA requires that all bacteriological samples be obtained with passing results within 30 days or less prior to system issuance of Affidavit of Punch List Completion. Any bacteriological tests performed more than 30 days prior to final acceptance and signature of the Affidavit of Punch List Completion by NTUA shall not be considered valid and shall be re-tested at no additional cost to the Owner.

L. Contractor must notify the Engineer at least five (5) working days prior to performing work within 100 feet of any culturally or paleontologically sensitive area, as designated on the Drawings.

M. The Contractor is responsible for obtaining all applicable local, county, state and tribal building and development permits not previously obtained by Engineer or Owner. This includes permits from the Construction Industries Division of the Regulation and Licensing Department of the State of New Mexico, and any other regulatory agency having jurisdiction.

N. Contractor is responsible for timely scheduling of any pertinent inspections with local, county, state and tribal agencies with jurisdiction, and as required by the permits.

O. Coordinate space requirements and installation of mechanical and electrical work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable.

P. All notices, demands, requests, instructions, approvals, proposals and claims must be in writing or email. Official email address(es) for notices will be designated during the pre-construction conference. Documents requiring written notice will be delineated at the pre-construction conference.

1. Any notice to or demand upon the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement or to the official contact email address designated at the pre-construction conference.

2. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the Contractor, be delivered to the Owner at the address stated on the signature page of the Agreement, and a copy shall be delivered to the Engineer at 5454 Venice Ave. NE, Suite D, Albuquerque, NM 87113.

3. Any such notice shall be deemed to have been given as of the time of actual delivery, in the case of mailing, when the same should have been received in due course of post, or in the case of telegrams, certified mail, or telephone facsimiles, at the time of actual receipt as the case may be.

Q. Coordination with Owner's Surveyor: Refer to Section 02 21 13 – Surveying.

R. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNAD a re-vegetation requirements and stipulations, provided in Appendix C.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

1.15 SUSPENSION OF WORK

A. The Owner may order suspension of work due to seasonal or other conditions unsuitable for construction work.

B. Maintenance during suspension: Prior to suspension for any cause, the Contractor shall take necessary precautions to protect the work during the period of suspension from any factors which would contribute to its deterioration.

C. Time elapsed during suspension of the work shall not count as contract time. The Contractor shall make no claim for damages due to delay, additional mobilization charges, nor any additional costs that may be incurred solely due to suspension of work.

D. Requests for additional time to be added after the "contract completion date" due to delays or extra work shall be made to the Owner in writing by the Contractor within ten (10) days after the time of the occurrence of the delay or receipt of a Change Order for extra work. Such requests shall set forth the justification for the additional time.

E. Upon approval, the additional contract time shall then be in full force and effect, the same as though it were the original date for completion and will be shown as the completion date plus an amount of additional working days. Any time required to complete the work beyond the contract time or additional contract time will result in the assessment of liquidated damages, as specified in the Contract Documents. Failure to make such requests within the above limits will be considered as a waiver on the part of the Contractor as to the need for additional contract time.

1.16 FIELD ENGINEERING

A. Establish elevations, lines, and levels and certify elevations and locations of the Work conforming with the Contract Documents.

B. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.

C. From the information provided by the Owner, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, easement

alignments, stakes for pipe locations and other working points, lines, elevations and cut sheets.

1.17 PRE-CONSTRUCTION CONFERENCE

A. Engineer will schedule Pre-Construction Conference after Notice of Award for affected parties.

B. The Contractor, or his duly authorized representative, and subcontractor representatives will attend the meeting.

1.18 PROGRESS MEETINGS

A. Schedule in coordination with the Engineer at maximum monthly intervals and attend all Progress Meetings throughout progress of the Work.

B. The purpose of the meetings will be to review the following:

1. Work progress since previous meetings.
2. Field observations, problems, conflicts.
3. Problems which impede construction schedule.
4. Corrective measures and procedures to regain projected schedule.
5. Revisions to construction schedule.
6. Plan progress and schedule during succeeding work period.
7. Coordination of schedules.
8. Off-site fabrication and delivery schedules.
9. Maintenance of quality standards.
10. Proposed changes, construction schedule and completion date.
11. Coordination of separate contracts.
12. Record or “as-built” drawings of completed work.
13. Other business as required.
14. Regulatory requirements including OSHA, New Mexico Board of Labor, and others as applicable.
15. Funding requirements including Bureau of Reclamtion and others as applicable.

C. During each meeting, the Contractor is required to present any issues which may impact his Work, with a plan to resolve these issues expeditiously.

D. Together with each payment application, Contractor must present the current as-built drawings reflecting all work performed to date.

1.19 CUTTING AND PATCHING

A. Submit written request in advance of cutting or altering elements with possible detrimental effects.

B. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.

C. Restore Work with new products according to requirements of Contract Documents.

D. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

E. Refinish surfaces to match adjacent finishes.

1.20 SUBMITTAL PROCEDURES

A. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

C. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of completed Work.

D. Revise and resubmit submittals as required by the Engineer; identify changes made since previous submittal.

E. Submit number of hardcopies Contractor requires, plus two hardcopies Engineer will retain, at a minimum, unless otherwise indicated at the Pre-Construction Conference. In addition, Contractor shall provide all submittals electronically in PDF format, unless otherwise directed by the Engineer.

F. Transmit each submittal with Engineer accepted form.

G. Provide a separate submittal for each item. Do not combine multiple distinct items into a single submittal without prior approval of Engineer. Improperly combined submittals shall be rejected.

H. Provide updated submittal log with each submittal. If multiple submittals are submitted concurrently, only one updated log needs to be provided with submittal package.

I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

1.21 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within fifteen [15] days after date of Owner-Contractor Agreement for Engineer review.

B. Submit revised schedules with each Application for Payment, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission. Interim applications for payment shall not be processed without updated schedules.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

1.22 PROPOSED PRODUCTS LIST

A. Upon submittal of Bid Form, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.23 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit copies and distribute in accordance with Submittal Procedures article.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

1.24 SHOP DRAWINGS

A. Shop Drawings:

1. Submitted to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

2. Include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items.

3. Design calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

4. After review, provide copies and distribute in accordance with Submittal Procedures article and for record documents purposes as specified.

5. Except as may otherwise be indicated herein, the Engineer will return copies of each submittal to the Contractor with comments noted thereon, within 30 calendar days following their receipt by the Engineer.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Submit number of opaque reproductions Contractor requires, plus two copies Engineer will retain.

1.25 TEST REPORTS

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.26 MANUFACTURER’S INSTRUCTIONS AND CERTIFICATES

A. When specified in individual specification sections, submit manufacturer printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. When specified in individual specifications sections, submit certifications by manufacturer to Engineer, in quantities specified for Product Data.

D. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.27 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer's instructions.

C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.28 TOLERANCES

A. Monitor fabrication and installation tolerance control of installed products over suppliers, manufacturers, products, site conditions, and workmanship, to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply fully with manufacturer's tolerances.

1.29 REFERENCES

A. Conform to reference standards by date of issue current as of date of Contract Documents.

B. When specified reference standard conflict with Contract Documents, request clarification from Engineer before proceeding.

1.30 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, require material or product suppliers or manufacturers to furnish qualified staff personnel to observe site conditions and to initiate instructions when necessary.

B. Report observations and site decisions or instructions that are supplemental or contrary to manufacturer's written instructions.

1.31 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify utility services are available, of correct characteristics, and in correct location.

C. Contractor is solely responsible for utility location, protection and verification. Contractor must notify New Mexico One Call System Inc., at 811, and all local utility providers (including NTUA's Call before you dig program 928-729-5721), at least three (3) days before starting utility line construction. Additional notice may be required for certain utilities, as noted on the Drawings and Specifications.

D. It shall be the responsibility of the Contractor to become acquainted with the location of all underground structures which may be encountered, or which may affect the Work hereunder.

1.32 TEMPORARY SERVICES

A. Provide, maintain and pay for suitable quality water service as required.

B. Maintain uninterrupted water and electric service to all properties adjoining the Work, including existing NTUA customers, at all times, except where specifically approved by the authority having jurisdiction. Services damaged by the Contractor shall be immediately and permanently repaired or replaced at the expense of the Contractor. Give a minimum of 48-hour advance notice to occupants of adjacent properties, including all existing NTUA customers, before interrupting any service. Any interruption of service shall be kept to the minimum length of time possible.

1. Contractor shall take necessary measures, including provision of temporary tanks and piping, to maintain uninterrupted water service until new tanks can be put back into service. Such temporary tanks, if needed, shall be provided at no additional cost to the Owner.

C. Until final inspection and approval of the Work and issuance of the Certificate of Substantial Completion, the Contractor is responsible for all Work directly or indirectly affected by the Contractor's activities. Such responsibility continues for all Work detailed on the punch list that may accompany the Certificate of Substantial Completion, until satisfactorily completed by the Contractor and approved by the Owner and Engineer.

D. Furnish, install and maintain any temporary water storage structures, electrical connections, meters, wiring, outlets, switches, lamps, etc., as necessary for the work. The Contractor shall provide such temporary heat as may be necessary for the prevention of injury to the work or material through dampness or cold. All temporary connections, installations, facilities and supplies furnished or installed as specified in this paragraph, shall be removed prior to the completion of the Contract, and the premises left perfectly clean and satisfactory to the Owner.

E. Maintain ambient temperature above freezing in enclosed/occupied areas where construction is in progress, unless indicated otherwise in specifications.

F. Provide and maintain required sanitary facilities and enclosures in clean and sanitary condition.

G. All temporary power costs/bills shall be borne by the Contractor until final project acceptance and signature of the Affidavit of Punch List Completion by NTUA.

1.33 ACCESS ROADS

A. The project right-of-way and temporary construction easement may be used for construction traffic. Do not construct any new roads. All trafficked areas must be restored to original condition prior to final completion of the project.

B. Existing on-site roads, designated by the Owner, may be used for construction traffic, provided the roads are not damaged and access to roads by local land users is not affected. Existing roads must be restored to original condition prior to final completion of the project.

1.34 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Maintain new and existing structures free of dust and construction debris at all times.

C. Remove waste and surplus materials, rubbish, and construction facilities from site. Restore all job sites and adjoining areas, including roads and driveways, to a condition equal to or better than the original status. Special attention will be made to not disturb unimproved roads by placing any excavated material to the sides of these roads when water lines are located along the right-of-way.

D. Brush and trees shall be felled parallel to the right-of-way to minimize damage to trees and structures on adjacent property. All brush, tree tops, stumps and other debris shall be removed from the right-of-way and disposed of by the Contractor, subject to and in conformity with the special provisions applying to the tract of land involved (if any). The Contractor shall not destroy nor remove any trees, shrubbery, nor any other improvements, without permission of the Owner.

E. The Contractor shall not dispose of debris, refuse or sanitary wastes in an open dump or in a natural watercourse, whether on public or private property, or in such places that undesirable wastes can eventually be exposed or carried to a natural watercourse.

F. Removal of obstructions required for completion of the project, whether specifically listed or not, shall be considered incidental to the work.

1. The Contractor shall remove and supply all usable materials to the Owner at a site designated by the Owner.

2. The Contractor shall remove and dispose of all unusable materials in accordance with relevant environmental regulations.

1.35 PROJECT IDENTIFICATION

A. Project sign requirements: None.

B. The Contractor shall not erect or permit the erection of advertising signs. Only minimal identification and direction signs shall be permitted on the site. Unnecessary or obnoxious posters, pictures, signs, symbols, drawings or writing on work, material or equipment, resulting from vandalism or other causes, shall be covered or removed by the Contractor.

1.36 BARRIERS AND FENCING

A. Provide barriers or fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.

1.37 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Contractor shall remain wholly responsible for protection of all stored materials and installed work until final acceptance of the project by the Owner and signed Affidavit of Punchlist Completion by NTUA.

1.38 SECURITY

A. Provide security and facilities to protect Work and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Security of Contractor’s equipment, stored materials, work, and staging areas shall be entirely the responsibility of the Contractor. The Owner assumes no liability for any damage, vandalism, or theft of Contractor’s property.

1.39 WATER CONTROL

A. Provide erosion control.

B. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Contractor must abide by all stipulations and requirements within the Storm Water Pollution Prevention Plan (SWPPP) to be provided by the Contractor throughout all construction phases, including all proposed pollution prevention and sediment control measures. This shall be done in accordance with the National Pollution Discharge Elimination System (NPDES) general permit requirements for all construction activities and shall include all required reporting. If the Bid Form does not include an item for preparation and implementation of the SWPPP, the cost thereof will be considered incidental to related work.

D. The Contractor shall conduct his operations to minimize damage to natural watercourses, and shall not permit petroleum products, volatile fluid wastes, or any other wastes which are prohibited by local ordinances, or excessive amounts of silt, clay, or mud to enter any drainage system. The bed of natural watercourses or man-made irrigation ditches shall be restored to normal gradient and cross-section after being disturbed.

E. Do not fill in any natural washes or drainages or impede natural water flow unless otherwise indicated in the plans or specifications, or directed by the Engineer in the field.

1.40 POLLUTION AND ENVIRONMENTAL CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Provide dust control, erosion and sediment control, noise control, pest control and rodent control to allow for proper execution of the Work. Motor equipment shall be kept in repair and equipped with anti-pollution devices, if possible, to cut down on exhaust emissions. Burning as a method of cleaning or disposal will not be permitted without approval of the proper authorities. Short term effects of dust produced by equipment will be mitigated by sprinkling traffic areas with water.

C. Comply with all applicable standards, orders, or regulations issued pursuant to the Clean Air Act of 1970 (42 U.S.C. 1251 et seq.) as amended. Violations shall be reported to the New Mexico Environment Department.

D. The Contractor shall be responsible for the reporting and the cleanup of spills associated with project construction and shall report and respond to spills of hazardous materials such as gasoline, diesel, motor oil, solvents, chemicals, toxic and corrosive substances, and other materials which may be a threat to the public health or the environment.

E. The Contractor shall be responsible for reporting past spills encountered during construction and of current spills not associated with construction. Reports shall be made to the New Mexico State Police at 575-289-3443 or 505-334-6622, or call the New Mexico Environment Department Emergency Response Team at 505-827-9329 and to the Owner's Resident Project Representative.

F. The Contractor shall clean up any unreported spills associated with project construction identified after construction.

G. Fuel, oil, hydraulic fluid, lubricants, and other petrochemicals must not be stored within the 100-year floodplain or within 100 ft of any wash and must have a secondary containment system to prevent spills.

H. Do not change or add oil, hydraulic fluid, or other petrochemical-based fluids to any piece of machinery within the 100-year floodplain or within 100 ft of any wash.

I. Appropriate spill clean-up materials such as brooms and absorbent pads must be available where materials are stored or equipment is working at all times.

1.41 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion review.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.42 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by the Contract Documents.

C. Provide interchangeable components of same manufacture for components being replaced.

1.43 DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. Deliver, handle, store, and protect Products in accordance with manufacturer's instructions.

1.44 SUBSTITUTIONS

A. Substitutions will only be considered when Product becomes unavailable through no fault of Contractor.

B. Specific manufacturers may be required for certain items in order to maintain consistency with the Owner's existing inventory. In such cases, substitutions may not be allowed.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. Submit three [3] copies of request for Substitution to the Engineer for consideration. Limit each request to one proposed Substitution.

1.45 CLOSEOUT PROCEDURES

A. Submit written certification Contract Documents have been reviewed, Work has been inspected, and Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Submit final Application for Payment identifying total adjusted Contract Price, previous payments, and amount remaining due.

C. Project closeout submittals shall include, but not limited to:

1. Affidavit of Punch List Completion
2. Project Record Documents
3. Operations and Maintenance Data
4. Spare Parts and Maintenance Materials
5. Extended Warranties
6. Release of Liens
7. Consent of Surety
8. Certification of Labor Standards
9. Complete packages of all testing results, start-up reports and data logs, including: manufacturer’s testing data, pipe fusion data logs, fusible PVC fusion tests, line purge records, bacteriological tests, pressure tests, concrete tests, compaction tests, weld x-rays, cathodic protection start-up reports, and other quality control/ quality assurance documentation required in the Specifications.

D. Affidavit of Punch List Completion must be signed by NTUA prior to Final Completion.

1. Final payment will not be processed until Affidavit of Punch List Completion is accepted by NTUA.
2. Warrantee period shall commence upon execution of Affidavit of Punch List Completion by NTUA.

1.46 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Upon completion of the work under this contract, thoroughly clean and make any needed repairs caused by damage during construction to any existing utilities or other structures on the site.

C. Notify the Engineer in writing once final cleaning is complete. The final payment will not be made until the Contractor has complied with all requirements set forth and the Engineer has made his final inspection of the entire work and is satisfied that it is properly constructed and the site properly cleaned.

D. All costs related to cleaning shall be considered incidental to the project.

1.47 STARTING OF SYSTEMS

A. Provide at least seven [7] days notification prior to start-up of each item. Contractor shall coordinate scheduling of such start-up services with the manufacturer and Engineer.

B. Ensure each piece of equipment or system is ready for operation.

C. Execute start-up under supervision of responsible persons in accordance with manufacturer's instructions.

D. Submit written report stating equipment or system has been properly installed and is functioning correctly.

1.48 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six [6] months.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

1.49 TESTING, ADJUSTING, AND BALANCING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Owner retains the right to appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.

C. Contractor will cooperate with independent firm; furnish assistance as requested.

D. Re-testing required because of non-conformance to specified requirements will be charged to Contractor.

1.50 PROTECTING INSTALLED CONSTRUCTION

A. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

B. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

C. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

D. Prohibit traffic from landscaped areas.

1.51 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of Contract Documents to be utilized for record documents.

B. Record actual revisions to the Work. Record information concurrent with construction progress.

C. Specifications: Legibly mark and record at each Product section description of actual Products installed.

D. Record Documents and Shop Drawings (As-Built Drawings):

1. Legibly mark each item to record actual construction.

2. Deliver two (2) sets of As-Built Drawings with redlines to the Owner upon completion of the Project.

E. If any surveying is provided by the Contractor to supplement Owner-provided surveying, submit records and digital survey data.

F. Submit updated record documents to Engineer together with claims for interim Application for Payment. Interim and final applications for payment shall not be processed without updated record documents.

G. All mapping and other documentation requirements associated with the Contractor's SWPPP shall be the responsibility of the Contractor.

1.52 OPERATION AND MAINTENANCE DATA

A. Submit 3 sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, 3 D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.

C. Internally subdivide binder contents with permanent page dividers, logically organized.

D. Contents:

1. Part 1: Directory

a. List names, addresses, and telephone numbers of Engineer, Contractor, subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions, arranged by system:

a. Equipment summary, operational procedures, preventive maintenance procedures and schedules, parts list, shop drawings, safety issues.

3. Part 3: Project documents and certificates.

a. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

1.53 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to project site and place in location as directed by Engineer; obtain receipt prior to final payment.

1.54 WARRANTIES

A. Contractor warrants to Owner that all materials and workmanship covered by this Agreement, collectively referred to as the Work, supplied or performed by the Contractor, Contractor's sub-contractors, or Contractor's suppliers, will conform with the specifications, drawings, and other descriptions supplied or adopted by Owner and will be new, fit, and sufficient for the purposes for which they are intended as evidenced in this Agreement and in the drawings and specifications referred to therein, of good material, design and workmanship, free from defects, and will fulfill satisfactorily the operating conditions specified herein.

B. Contractor shall execute and assemble transferable warranty documents from subcontractors, suppliers, and manufacturers for all products with extended warranties beyond one (1) year.

C. Contractor shall submit all warranty documentation prior to final Application for Payment.

D. All warranty periods shall commence upon the date of final acceptance of the work and execution of the Affidavit of Punch List Completion by NTUA.

E. If during the warranty period, any Work fails to conform with the foregoing guarantees, the defective Work shall be promptly repaired or replaced per these specifications and to the satisfaction of the Owner, at no cost to the Owner, including but not limited to prepayment of all packing and transportation costs; the cost of excavation, removal, and replacement of the defective material and all other adjacent materials affected by these actions; the cost of bedding and compaction and all required testing; as well as the costs of construction oversight, management and testing of materials by the Engineer.

F. Contractor will not be chargeable for repairs made by Owner to correct such failure within the foregoing warranty unless Contractor has been given written notice of such failure and thereafter has failed to take prompt and effective action to correct the failure in accordance with the foregoing.

1.55 RESIDENT PROJECT REPRESENTATIVE

A. The Owner shall provide a Resident Project Representative (RPR) to observe construction of the project.

B. The RPR shall:

1. Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

2. Serve as Engineer’s liaison with Contractor, working principally through Contractor’s authorized representative, assist in providing information regarding the intent of the Contract Documents.

3. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.

4. Conduct on-Site observations of Contractor’s work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

5. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner’s personnel, and that Contractor maintains adequate records thereof.

6. Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the schedule of values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

7. During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered

to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

8. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and preparation of punch lists.

9. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final list of items to be completed and deficiencies to be remedied.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including “or-equal” items).

2. Exceed limitations of Engineer’s authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor’s work.

5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.

8. Authorize Owner to occupy the Project in whole or in part.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02 21 13

SURVEYING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surveying services to be provided by Owner related to establishment of elevations, lines, and levels and certification of elevations and locations of the Work conforming to the Contract Documents.

2. Contractor's responsibilities in support of Owner-provided surveying and additional surveying work to be paid by Contractor.

B. Related Sections:

1. Section 01 00 00 - Basic Requirements: Field Engineering.

2. Section 31 23 17 - Trenching: Execution requirements for trenching.

3. Section 31 23 23 - Backfill.

4. Section 33 11 13 - Public Water Transmission Systems.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Construction Staking and As-Built Surveying:

1. Owner shall provide the surveying services specifically delineated in this section at no cost to the Contractor.

2. Any additional surveying services shall be provided at Contractor's sole expense and shall be considered incidental to the project.

a. Surveying services provided by any other surveyor shall be subject to Owner's approval of the surveyor's qualifications.

3. Contractor support required herein, and any other reasonable Contractor support for Owner-provided Surveyor, shall be provided at Contractor's sole expense and shall be considered incidental to the project.

1.3 PRIMARY CONTROL

A. The Engineer will establish primary control to be used for establishing work lines and grades.

B. Primary control will consist of benchmarks and horizontal control points in work vicinity.

C. Contractor shall preserve and maintain primary control points until otherwise authorized. Engineer may reestablish damaged or destroyed primary control points and back charge cost to the Contractor.

1.4 RIGHT-OF-WAY AND TEMPORARY CONSTRUCTION EASEMENT

A. Contractor is advised that a 40’ wide permanent right-of-way (ROW) easement is established along the proposed pipeline alignment, 20’ to each side of the centerline. An additional 30’ is provided on each side of this permanent easement to provide a temporary construction easement (TCE), resulting in a total of 100’ wide corridor to which the Contractor must limit all construction activities, staging, and construction traffic.

B. Contractor is advised that at certain locations the temporary construction easement is truncated on one side or both sides to avoid encroaching on culturally sensitive areas or adjacent properties. These truncated areas are indicated on the Drawings and will be barricaded by the Owner’s Surveyor. Contractor shall not encroach beyond the established work space in these areas.

C. Contractor shall not work in any area where the designated work area has not been staked by Owner’s Surveyor.

D. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 OWNER-PROVIDED SURVEY SERVICES

The Owner’s Surveyor (herein defined as New Mexico-licensed Professional Surveyor or his designated field representative, contracted directly by the Owner) shall provide the following services at no cost to the Contractor:

A. Construction Staking:

1. ROW/ TCE limit Staking:

a. Owner’s Surveyor will stake the TCE boundaries every 100 feet and at all horizontal points of inflection.

b. Where the temporary construction easement is truncated to avoid culturally sensitive or restricted areas, the Owner’s Surveyor will barricade the truncated ends of the temporary construction easement with multiple stakes spaced no more than 10 ft apart to protect against inadvertent encroachment outside the designated work area by construction personnel or others.

2. Pipe Centerline and Profile Staking:

a. Owner’s Surveyor will stake the pipe centerline, with offsets as requested by Contractor, at the following intervals:

1) Every 50(+/-) feet

2) All vertical points of inflection

3) At all horizontal points of inflection

4) At all valves, fittings, and other appurtenances, as shown on the Drawings

5) At all locations with additional minimum cover specified on the Drawings

b. Offset between pipe profile stakes and pipe horizontal centerline to be specified in writing by Contractor on the "Owner-Provided Survey Request Form".

c. Owner-provided stakes will provide vertical depth from hub to pipe.

1) Contractor shall specify in writing on "Owner-Provided Survey Request Form" if vertical depths on pipe profile stakes are desired to be measured to top of pipe, pipe vertical centerline, or pipe invert. This measurement convention shall be used consistently throughout the entire project.

3. Structures and Site Staking:

a. Owner's Surveyor will provide the following staking for the pump station site:

1) Rough grading/ slope stakes, for pads and driveways

2) Sub-grade/ base course fine grading hubs, for pads and driveways

3) Site improvement stakes

a) Tank foundations

b) Building foundations

c) Vaults and manholes

d) Valves (center of valve)

e) Site piping and appurtenances

f) Fencing

g) Driveways

4) Temporary benchmarks for all Contractor's use

b. Contractor shall be wholly responsible for proper alignment of all pipes, utilities, and foundations in the field, including flange locations and elevations of pipe risers at tank.

c. Tank overflow elevations: Owner's Surveyor will provide a benchmark in the vicinity of each tank. Contractor shall be wholly responsible to determine proper tank overflow elevations based on these benchmarks. Owner's surveyor will not survey the weir elevations of new tank prior to as-built survey.

4. Roads:

a. Slope stakes every 100 feet, left and right side.

b. Fine grading hubs every 50 feet on tangent and every 25 feet on curves.

c. Stake culverts.

B. As-builts:

1. Pipe:

a. The centerline of pipe shall be surveyed after laying and embedment of pipe in trench but prior to placing backfill over the top of the pipe or other features to be surveyed.

b. Any pipe that is backfilled prior to as-built surveying shall be uncovered at Contractor's sole expense to allow for surveying.

c. If the pipe is found to be outside of the line and grade specifications established in Section 33 11 13 - Public Water Transmission Systems, Contractor will be required to correct line and grade and have the corrected work re-surveyed at Contractor's sole expense.

d. If the Engineer suspects that the pipe has floated, shifted during placement or compaction of embedment, or otherwise moved after as-built surveying, the affected portion shall be re-surveyed as directed by the Engineer. All conditions noted above for pipe found to be outside line and grade specifications shall apply equally to re-surveyed pipe.

1) If the pipe is found to have moved, the cost of re-surveying shall be borne by the Contractor.

2) If the pipe is found not to have moved, the re-surveying shall be provided at no cost to the Contractor.

e. Only actual measurement of top of the pipe shall be accepted. No as-built reference points shall be accepted, without prior approval by the Engineer.

f. Wash crossings with specified additional cover: In addition to surveying the pipe, Owner's Surveyor shall also survey a cross-section of the existing grade of the wash itself to verify depth of cover from the bottom of the wash to the top of the pipe.

1) Where possible the wash cross-section will be surveyed at the pipe centerline prior to ground disturbance at the wash.

2) If wash cross-section surveying is required after ground disturbance (such as at the time the pipe is as-built surveyed), a representative cross-section of the wash to the right or left of the pipe crossing may be surveyed instead.

2. Structures and sites:

a. Owner's Surveyor shall certify location and elevation of buildings and tanks after completion of the foundation, but prior to construction of structures on the foundation.

b. Owner's Surveyor shall certify tank overflow weir elevations after tank erection.

c. Owner's Surveyor shall survey all valves, vaults, fence corners, culverts, key drainage features, drain pipe outfalls, and other features within the sites.

d. Owners' Surveyor shall survey pressure pipes and drain pipes within the pump station site to ensure compliance with minimum slope requirements.

3. Roads:

a. Owner's Surveyor shall provide as-built surveying for all culvert ends.

b. As-builts for road surface and associated drainage ditch shall be based on the blue tops provided by the Owner's Surveyor.

c. In the event that actual construction differs from the blue tops, the road shall be as-built surveyed at the Contractor's expense.

4. Existing utilities:

a. Any existing utilities, such as existing gas lines or water lines crossed by the project, shall be surveyed by the Owner's Surveyor after being potholed by the Contractor.

5. As-built surveying intervals:

a. Pipeline:

1) Every 50(+/-) feet along main pipeline

a) For site piping, closer spacing may be required to ensure adequate slope

2) All vertical points of inflection

3) At all horizontal points of inflection

4) At all valves, fittings, and other appurtenances, as shown on the Drawings

5) At all locations with additional minimum cover specified on the Drawings

b. Valves and pipe fittings:

1) Centerline of pipe at all risers for air valves

2) Centerline of all in-line valves

a) For butterfly valves survey operating nut as well as center of valve

3) Centerline of all fittings, such as tees, wyes and ells

4) For flush valves, centerline of all valves, risers, horizontal and vertical points of inflection, and outfalls

c. Structures:

1) Center of rims for all manholes and vaults

2) Building foundation corners

3) Tank base, surveyed at four locations at 90 degrees to each other

3.2 CONTRACTOR SUPPORT AND COORDINATION

A. Contractor shall provide Owner's Surveyor with a minimum of 48 business hours notice to commence any surveying activity, such as construction staking or as-built surveying,

1. Contractor shall use the "Owner-Provided Survey Request Form" (for Owner-provided survey work) provided in Exhibit G to the Contract Documents.

2. Contractor shall not bury any Work requiring as-built survey prior to being surveyed.

3. If, and only if, the Owner's Surveyor is not available to provide as-built surveying within 48 business hours, or if the Work must be backfilled in less than 48 business hours due to unforeseeable circumstances beyond the Contractor's control, then the Contractor will be allowed to backfill the Work under one of the following conditions, subject to Engineer's approval:

a. Contractor sets reference points at station, offset, and cut or fill to the top of pipe every 50 feet and at all high and low points, or

b. Contractor potholes the Work at a later date

B. Contractor responsible to coordinate schedule and pace of work with Owners' Surveyor, and pace work accordingly.

1. Contractor shall provide the Owner's Surveyor with updated work schedules throughout the project.

2. Contractor shall request a minimum of one (1) mile of ROW/ TCE limit staking at a time.

3. Contractor shall request a minimum of one-half (1/2) mile of pipe centerline staking at a time. Contractor shall not request pipe centerline staking until the area has been cleared and grubbed.

4. Contractor shall request a minimum of 1,000 LF of pipe as-built surveying at a time. Contractor may submit request for as-built surveying prior to actual pipe installation at Contractor's own risk; Contractor shall be back-charged for standby time if the pipe is not ready for surveying at the scheduled time.

C. Contractor shall provide safe access for Owner's Surveyor to survey as-built facilities in accordance with this section, including pipe within uncovered trenches. All locations which Owner's Surveyor must access must meet OSHA safety standards for the Owner's Surveyor, as judged by the Surveyor. The Owner's Surveyor reserves the right to refuse to enter any location he or she deems to be unsafe, in which case it shall be the Contractor's responsibility to provide the Owner's Surveyor safe access to the locations that must be surveyed. In case of any dispute as to the safety of a particular location for the Surveyor to enter, the Owner reserves the right to contact OSHA for a determination.

1. Neither the Owner, nor the Engineer, nor the Owner's Surveyor will make any determination or assume any responsibility regarding the safety of any aspect of the project for the Contractor's own personnel or sub-contractors.

2. Beyond provision of safe access to facilities requiring survey, Contractor assumes no responsibility for Owner's Surveyor's, Engineer's, or Owner's safety.

D. Contractor shall coordinate with Owner's Surveyor regarding desired location of Owner-provided benchmarks.

3.3 RE-STAKING AND CORRECTION OF SUB-STANDARD WORK

A. All construction staking will be provided one time at no cost to the Contractor.

1. Any required re-staking due to Owner-requested changes to the Work shall be provided at no cost to the Contractor.

2. Any re-staking not due to Owner-requested changes shall be at Contractor's sole expense.

B. Any stake removed, damaged beyond usability, or moved from its original location shall be replaced by the Owner's Surveyor at Contractor's expense.

C. In the event that any pipe or other facility moves after it has been surveyed for as-builts, it shall be re-surveyed at Contractor's expense.

D. Any sub-standard work that needs to be re-installed shall be re-surveyed at Contractor's sole expense.

1. In the case of pipeline that fails to meet line and grade requirements, the Contactor shall be responsible for the cost of re-excavation, re-installation, re-embedment, re-compaction, re-surveying and re-testing of any embedment material that must be removed in order to correct pipe line and grade.

3.4 ADDITIONAL SURVEYING SERVICES

A. All Additional Surveying Services shall be borne at the Contractor's sole expense.

B. Additional Surveying Services include:

1. Re-staking

2. Re-surveying of sub-standard work

3. Re-surveying of work that has moved subsequent to as-built surveying

4. Any surveying associated with Best Management Practices (BMPs) included in the Contractor's SWPPP

5. Any surveying services not specifically delineated in this Section as Owner-provided surveying services

3.5 ACCURACY

A. Degree of accuracy of surveying:

1. Horizontal and vertical alignment of pipeline tangents and curves: Within 0.10 ft.

2. Structure Points: Set within 0.03 foot, except where installation or operation considerations require tighter tolerances.

3. Blue Tops: Set within 0.03 foot.

4. Cross-Section Points: Locate within 0.10 foot, horizontally and vertically.

5. Benchmarks: Set within 0.08 foot, horizontally and vertically.

3.6 DISCREPANCIES

A. Contractor, Engineer, and Owner's Surveyor shall notify each other immediate upon the discovery of any discrepancies in the plans, surveys, or staking. The Engineer, in consultation with the Contractor and Owner's Surveyor, shall promptly review the discrepancies and issue corrections or clarification. If the Contractor elects to proceed with construction before such corrections or clarifications are made, Contractor shall do so at Contractor's own risk and expense.

B. Any claims by the Contractor against the Owner's Surveyor of inaccurate construction stakes must be substantiated based on the original, intact stakes. The Contractor shall not make any claim against the Owner's Surveyor of alleged inaccurate construction stakes unless all survey stakes set by the Owner's Surveyor are maintained and can be verified as to their origin.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials for concrete formwork, bracing, shoring and supports and shall design and construct all forms, bracing, shoring and falsework, all in accordance with the requirements of the Contract Documents.

B. Section Includes:

1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Form accessories.
4. Form stripping.

C. Related Sections:

1. Section 03 20 00 - Concrete Reinforcement.
2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. International Building Code (IBC), as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition

B. American Concrete Institute:

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

C. Government Standards:

1. PS 1-74 U.S. Product Standard for Concrete Forms, Class I.

D. American Forest and Paper Association:

1. AF&PA - National Design Specifications for Wood Construction.

E. The Engineered Wood Association:

1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

F. ASTM International:

1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. List of form materials and locations of use.

2. Form release agent with EPA Certification.

1.4 QUALITY ASSURANCE

A. Tolerances: The variation from established lines and grades shall not exceed 1/4-inch in ten (10) feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the "Suggested Tolerances" specified in Section 3.3 and 3.4 of ACI 347.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use as forms, shoring or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

1. Exposed vertical and horizontal surfaces: Steel or plywood panel. Wood grain finish not permitted.

2. All Other Work: Steel panels, plywood or tongue and groove lumber.

2.2 FORM TIES

A. Form ties with Integral water stops shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete.

1. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-inch and all such fasteners shall be such as to leave holes of regular shape for reaming.

2. Form ties for water-retaining structures shall have integral water stops. Removable taper ties may be used when approved by the Engineer. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

2.3 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS10.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements for PS 1 for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms. Forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework and shoring shall comply with applicable Local, State and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines and dimensions of structural components as called for on the Drawings and shall be free from surface defects and sufficiently tight to prevent leakage.

3.3 FORM DESIGN

A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

B. Suitable and effective means shall be provided on all forms for holding adjacent edges and end of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets or similar surface defects in the finished concrete.

C. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The form joints shall be tight so as to prevent the loss of water, cement and fines during the placing and vibrating of the concrete. The bottom of the wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Adequate cleanout holes shall be provided at the bottom of each lift of forms.

3.4 INSTALLATION

A. Formwork - General:

1. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.

2. All vertical surfaces of concrete members shall be formed.

3. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.

4. Complete wedging and bracing before placing concrete.

B. Forms for Smooth Finish Concrete:

1. Use steel, plywood or lined board forms.

2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.

3. Install form lining with close-fitting square joints between separate sheets without springing into place.

4. Use full size sheets of form lines and plywood wherever possible.

5. Tape joints to prevent protrusions in concrete.

6. Use care in forming and stripping wood forms to protect corners and edges.

7. Level and continue horizontal joints.

8. Keep wood forms wet until stripped.

C. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

D. Framing, Studding and Bracing:

1. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
2. Distribute bracing loads over base area on which bracing is erected.
3. When placed on ground, protect against undermining, settlement or accidental impact.

E. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

G. Obtain Engineer’s approval before framing openings in structural members not indicated on Drawings.

H. Install fillet and chamfer strips on external corners of beams, joists, and/or columns, as called for on the Drawings.

I. Install void forms in accordance with manufacturer's recommendations.

3.5 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with release agent manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”.

E. Apply form coatings before placing reinforcing steel.

3.6 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

D. Install water stops continuous without displacing reinforcement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

G. Form Ties:

1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Leave inner rods in concrete when forms are stripped.
3. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.
4. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03 30 00 - Cast-In-Place Concrete.
5. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete form stripping or tie removal will not be permitted.
6. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

H. Removable Ties:

1. Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond.
2. A precast neoprene or polyurethane taped plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink grout for above-grade walls that are dry on both sides.
3. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:

1. Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer.
2. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
3. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
4. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
5. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Specification sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

L. Openings for Items Passing Through Concrete:

1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.7 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to cleanliness, strength, rigidity, tightness and smoothness of surface. After forms have been removed from a concrete placement they shall be immediately and thoroughly cleaned and repaired and surface treated before reuse.

B. The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Oil shall be kept off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.8 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.

B. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained seventy-five percent (75%) of the specified 28-day strength and has been in place for a minimum of seven (7) days. Forms for all vertical walls and columns shall remain in place at least forty-eight (48) hours after the concrete has been placed, except for periods of cold weather when forms shall remain in place at least seventy-two (72) hours after concrete has been placed.

C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

E. Leave forms in place for minimum number of days as specified in ACI 347.

3.9 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces that are permanently exposed to view.

3.10 FALSEWORK

A. The Contractor shall be responsible for the design, engineering, construction, maintenance and safety of all falsework, including staging, walkways, forms, ladders and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.

B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the required dead load plus a minimum of 40 psf live load. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time. Falsework shall be placed upon a solid footing, safe against undermining and protected from softening. When falsework is supported on any portion of the structure that is already constructed, the load imposed by the falsework shall be spread, distributed and braced in such a way as to avoid any possibility of damage to the structure. Falsework supported off finished floor slabs shall be set in such a way to protect the finish floor surface from being scarred, chipped or gouged.

3.11 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish, fabricate and place all concrete and masonry reinforcement steel, including all the tie wires, clips, supports, chairs, spacers and other accessories, all as shown and specified in the Contract Documents. All requirements included on the Drawings shall apply and shall take precedent over any indications in the present Section of the technical specifications in the case of contradictions.

B. Related Sections:

1. Section 03 10 00 - Concrete Forms and Accessories.

2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. Codes:

1. The International Building Code, as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition of International Building Code (IBC).

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 315 - Details and Detailing of Concrete Reinforcement.

3. ACI 318 - Building Code Requirements for Structural Concrete.

4. ACI SP-66 - ACI Detailing Manual.

C. ASTM International:

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

3. ASTM A185 - Specification for Welded Steel Wire Fabric (Latest Edition) for Concrete Reinforcement.

4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

6. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

7. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
8. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
9. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.

D. American Welding Society:

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

E. Concrete Reinforcing Steel Institute:

1. CRSI - Manual of Standard Practice (Latest Edition).
2. CRSI - Placing Reinforcing Bars (Latest Edition).

F. Wire Reinforcement Institute:

1. Manual of Standard Practice for Welded Wire Fabric.

1.3 SUBMITTALS

A. The Contractor shall furnish to the Engineer reinforcing steel placing drawings. These drawings shall show the number, grade, size, length, mark, location and bending diagrams for all reinforcing steel and related products, together with lists of bent and straight bars in accordance with the ACI Detailing Manual (latest edition) of the American Concrete Institute and the requirements specified herein and shown on the Contract Drawings. The Engineer may or may not review the placement drawings. Any review of the placement drawings by the Engineer will be limited to general compliance with the Contract Documents and will not be returned to the Contractor. Reinforcing steel placement will be checked in the field using the design drawings. Any discrepancies, errors or omissions from the requirements of the Contract Documents shall be corrected prior to placement of concrete and at the sole expense of the Contractor.

1.4 QUALITY ASSURANCE

A. When required by any applicable permits, such as CID permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

B. If requested by the Engineer, the Contractor shall provide a certified copy of the mill test report showing physical and chemical analysis for each heat of reinforcement steel delivered.

PART 2 PRODUCTS

2.1 REINFORCEMENT STEEL

A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A615 for Grade 60 Billet Steel Reinforcement.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 and the details shown. Welded wire fabric with longitudinal wire equal to or less than 4.0 size wire shall be either furnished in flat sheets or in rolls with a core diameter or not less than 10-inches. Welded wire fabric with longitudinal wires larger than 4.0 size shall be furnished in flat sheets only.

B. Accessories:

1. The Contractor shall furnish and install all accessories including necessary chairs or bolsters, concrete blocks (dobies), tie wires, supports, spacers and other devices to position reinforcement during concrete placement.

2. Wire bar supports shall be made of plain cold-drawn steel wire with pre-molded, gray-colored, plastic tips to the legs of the support. The plastic shall have a thickness of 1/8-inch or greater at points of contact with formwork and extend upward on the wire a minimum of 1/2-inch. Wire sizes and geometric dimensions shall be made in accordance with Table II of the latest edition of CRSI Manual of Standard Practice.

3. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Where the concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.

4. The wire tie shall be 16-gauge or heavier, black annealed.

2.2 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where shown and where approved by the Engineer. The couplers shall develop a tensile strength that exceeds one hundred fifty percent (150%) of the yield strength of the reinforcement bars being spliced at each splice.

PART 3 EXECUTION

3.1 GENERAL

A. All reinforcement steel, welded wire fabric, couplers and other appurtenances shall be fabricated and placed in accordance with the requirements of the Contract Documents, including referenced specifications, codes and standards.

3.2 FABRICATION

A. Reinforcement steel shall be accurately fabricated to the dimensions and shape shown in the Contract Documents. Fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings. Bends shall conform to bend dimensions defined as standard in accordance with details in the ACI Detailing Manual and/or CRSI Manual of Standard Practice, unless otherwise shown. Bars shall be bent cold and shall not be bent or straightened in a manner that will injure the material. All hooks shall conform to bend dimensions defined as ACI Standard Hooks.

B. The Contractor shall fabricate reinforcement bars within the tolerances shown in the ACI Detailing Manual and/or CRSI Manual of Standard Practice.

C. Reinforcing bars delivered to the field shall be tagged with durable material and marked in a legible manner with waterproof markings. Tags shall show the grade, number of pieces, size and mark or length of bars.

3.3 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Contract Documents and placed per the minimum clearance requirements given on the Drawings and shall be adequately supported and wired together to prevent displacement. All reinforcement steel shall be supported or spaced off the forms by concrete or metal supports which are rigid enough to prevent any displacement or the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement. Concrete blocks shall not be used as spacers between mats. All concrete blocks used to space reinforcement steel off vertical formed surfaces shall be tied to the steel with wire ties which are embedded in the blocks. For reinforcement including welded wire fabric over formwork, the Contractor shall furnish concrete or metal supports with plastic covered legs for bar supports.

B. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

C. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

D. Placing Tolerances: Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318, except where in conflict with the requirements of Building Code.

E. Bars may need to be moved to avoid interference with other reinforcement steel, conduits or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer. Additional bars may be necessary to prevent cracking or provide additional reinforcement in this case and shall be provided by the Contractor at its own expense.

F. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than three (3) feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.4 SPACING OF BARS

A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than 1-inch.

3.5 SPLICING

A. General: Reinforcement bar splices shall only be used at locations shown, unless otherwise acceptable to the Engineer.

B. Splices of Reinforcement: The length of lap for reinforcement bars, unless otherwise shown shall be in accordance with ACI 318, Section 12.15.1 for a class C splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each two (2) running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent, except as specifically permitted by the Engineer.

3.6 CLEANING AND PROTECTION

A. Reinforcing steel delivered to the jobsite shall be suitably stored off the ground and protected from oils, mud, concrete splatter and all conditions conducive to corrosion until embedded in concrete.

B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary, recleaned.

END OF SECTION

SECTION 03 29 00

JOINTS IN CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall construct all construction joints, expansion joints and control joints in concrete at the locations shown and formed in accordance with the details shown in the drawings.

B. Related Sections:

1. Section 03 10 00 - Concrete Forms and Accessories.
2. Section 03 20 00 - Concrete Reinforcement.
3. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. Federal Specifications:

1.	TSS-S-00227E(3)	Sealing Compound, elastomeric type, multi-component (for Caulking, Sealing, Glazing Buildings and Other Structures)
2.	CRD-C 572	U.S. Army Corp of Engineers Specifications for PVC Waterstop

B. Commercial Standards:

1.	ASTM C 920-86	Specification for Elastomeric Joint Sealants
2.	ASTM D 624-81	Test Method for Rubber Property - Tear Resistance
3.	ASTM D 1752-84	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.3 QUALITY ASSURANCE

A. Construction Joint Sealant: The Contractor shall prepare adhesion and cohesion test specimens as specified herein from each shipment of material received at the jobsite. Sealant shall be stored at room temperature and shall not be stored longer than seventy-five percent (75%) of the manufacturer's stated shelf life.

B. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure:

1. Sealant specimen shall be prepared between two concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1/2-inch. Coated spacers (2-inch by 1-1/2 inch by 1/2-inch) shall be used to ensure sealant cross-sections of 1/2-inch by 2-inches with a width of 1/2-inch.

2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall not exceed twenty-four (24) hours.

3. Following curing period, the gap between blocks shall be widened to 1-inch. Spacers shall be used to maintain this gap for twenty-four (24) hours prior to inspection for failure.

PART 2 EXECUTION

2.1 JOINT CONSTRUCTION

A. Joint Location: Construction joints, expansion joints and control joints shall be provided where shown. When not shown, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. The location of all joints shall be submitted for acceptance by the Engineer.

B. Special care shall be used in preparing concrete surfaces at joints where bonding between two (2) sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls and wall to slab joints. Surfaces shall be prepared by sandblasting and washing for removal of latence or any objectionable material. Joints shall be kept clean until the concrete is placed. Vertical joints shall be clean and free of concrete fins, rock pockets or any objectionable material.

C. Sealant grooves shall be formed as shown on the drawings and shall be protected from damage until final application of the sealant. Care shall be taken to prevent chipping of the sealant grove during removal of forms.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, in accordance with the requirements of the Contract Documents. All requirements included on the Drawings shall apply and shall take precedent over any indications in the present Section of the technical specifications in the case of contradictions.

B. The following types of concrete shall be covered in this Section:

1. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, pavements, thrust blocks, fence and guard post embedment, and other concrete ties unless otherwise shown.

2. Structural Concrete: Concrete to be used where noted in the Contract Documents.

3. Lean Concrete: Concrete to be used for pipe trench cut-off walls and cradles, where the preceding items are detailed on the Drawings as un-reinforced.

4. Duct Bank Concrete: Red colored concrete to be used for electrical duct banks.

C. The term "hydraulic structure" used in these specifications shall refer to environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, or other fluids.

D. Related Sections:

1. Construction Drawings - General Notes and Specifications.

2. Section 03 10 00 - Concrete Forms and Accessories.

3. Section 03 20 00 - Concrete Reinforcement.

4. Section 03 29 00 - Joints in Concrete.

5. Section 03 60 00 - Grout.

6. Section 31 23 23 - Backfill.

7. Section 32 31 13 - Chain Link Fences and Gates.

8. Section 33 11 13 - Public Water Transmission Systems.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.

3. ACI 301 - Specifications for Structural Concrete.

4. ACI 306 - Cold Weather Concreting.
5. ACI 308.1 - Standard Specification for Curing Concrete.
6. ACI 309 - Consolidation of Concrete.
7. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete.
5. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
6. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C156 - Test Methods for Water Retention by Concrete Curing Materials.
10. ASTM C157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.
11. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
12. ASTM C192 - Method of Making and Curing Concrete Test Specimens in the Laboratory.
13. ASTM C227 - Test for Potential Alkali Reactivity of Cement- Aggregate Combinations.
14. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
15. ASTM C309 - Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C441 - Test for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to Alkali-Aggregate Reaction.
17. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
18. ASTM C1077 - Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction & Criteria for Laboratory Evaluation.
19. ASTM D2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
20. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

1.3 SUBMITTALS

A. General**:** Submittals shall be submitted to the Engineer for review in accordance with Section 01 00 00, Contractor Submittals. Submittals shall include, but not be limited to the following:

1. Mix Designs**:** Prior to beginning the Work and within 14 days of the Notice To Proceed, the Contractor shall submit to the Engineer, for review, the proposed ready-mix supplier and their Laboratory-Certified concrete mix design for each class and type of concrete specified for the Work. Submitted mix designs shall have been performance-tested and certified by an independent laboratory approved by the Owner. Physical properties, including slump, air content, density and compressive strength shall be included with the submitted tests. All costs related to providing mix design shall be borne by the Contractor. Mix designs shall show the following in accordance with ACI 301:

   a. Proportions for all materials proposed.

   b. Mill tests for cement.

   c. Admixture certification, chloride ion content must be included.

   d. Aggregate gradation and certification.

2. Delivery Tickets: Where ready-mix concrete is used, the Contractor shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring and the total quantities, by weight of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate added at the batching plant, and the amount allowed to be added at the site for the specific design mix. In addition, each ticket shall state the approved mix design number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the site, when unloading began, and when unloading was finished.

3. Materials and methods for curing:

   a. List of curing methods to be used on each type and class of concrete.

   b. Curing compound.

   c. Curing blankets and mats.

   d. Evaporation retardant.

1.4 QUALITY ASSURANCE

A. When required by any applicable permits, such as Construction Industries Division (CID) permits, Contractor shall have reinforcement inspected by the agency with jurisdiction prior to placement of concrete.

B. General:

1. Tests on concrete will be field performed in accordance with all requirements of applicable ASTM standards for such tests, including but not limited to obtaining samples, temperature, slump, air entrainment, making and curing specimens, breaking concrete cylinders, and other as may be applicable.

2. The cost of all laboratory tests on cement, aggregates, and concrete, for the development of the mix design, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C1077.

3. Concrete for testing shall be supplied by the Contractor as part of the project cost, and the Contractor shall provide assistance in obtaining samples, and disposal and cleanup of excess material.

4. Test cylinders will be prepared one (1) test each day of placement for each mixture for the first 50 or less cubic yards and one (1) test for each additional 100 cubic yards of concrete.

C. Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as indicated above to ensure continued compliance with these specifications. Each set of test specimens will be a minimum of 5 cylinders.

2. Compression test specimens for concrete shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.

3. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days and 2 at 28 days. The remaining cylinders will be held to verify test results, if needed.

4. Compression testing will be paid for by the Owner.

D. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, and as specified herein.

2. All concrete that fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.

3. Concrete delivered to the site that does not meet the requirements as herein specified may be rejected.

1.5 CONSTRUCTION TOLERANCES

A. The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the specifications, permissible deviations will be in accordance with ACI 117.

B. The following construction tolerances are hereby established and apply to finished walls and slabs unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the level or from the grades shown.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation from the plumb.	In 10 feet: 1/4-inch In 20 feet or more: 1/2-inch
Variation in the thickness of slabs and walls.	Minus 1/4-inch; Plus 1/2-inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4-inch

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. All cast-in-place concrete at the site(s) shall be:
1. All cement, unless sulfate tests dictate otherwise, shall be standard brand Portland Cement conforming to ASTM C150 for Type II, low alkali.
2. Portland Cement shall contain not more than 0.60 percent total alkalies. The term "alkalies" is defined as the sum sodium oxide (Na_2O), potassium oxide (K2O), calculated as sodium oxide (.658 K2O).
3. Only one (1) brand of cement shall be used for exposed concrete in any individual structure. The cement shall be suitably protected from exposure to moisture until used. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer. Mill test reports shall include the alkali content.

B. Water shall be potable, clean and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purpose of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

C. All concrete aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, sound, uniformly graded and free of deleterious material in excess of allowable limits specified. Combined aggregates shall be well graded from coarse to fine sizes, and be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Lightweight sand for fine aggregate will not be permitted. Aggregates shall conform to ASTM C33.

1. Coarse Aggregate: Coarse aggregate shall consist of gravel, crushed gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter or other foreign substances. Thin or elongated pieces having a length greater than four (4) times the average thickness shall not exceed fifteen percent (15%) by weight. Deleterious substances shall not be present in excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed one and one-half percent (1.5%):

Soft Fragments	1.5%
Shale	1.5%
Coal and Lignite	0.25%
Clay Lumps	0.25%
Materials Finer than No. 200 Sieve	0.50%*

*Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount maybe 1%.

Except as otherwise specified or approved in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C33, size No. 57.

2. Fine Aggregate: Fine aggregate for concrete or mortar shall consist of clean, natural sand or a combination of natural and manufactured sands that are hard and durable. Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed three percent (3%):

Removed by Decantation (Dirt, Silt, Etc.)	3%
Shale	1%
Clay Lumps	1%

Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than a standard color when tested in accordance with ASTM C40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00. Except as otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the requirements of ASTM C33.

D. If non-reactive aggregates are unavailable, and either the coarse or fine aggregates are found to be alkali-silica reactive, the Contractor shall submit a proposed design mix that effectively mitigates the alkali-silica reactivity, per ASTM C441. The admixture will be considered effective if the mean mortar bar expansion at 14 days is less than or equal to 0.10%.

E. Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. The use of calcium chloride will not be permitted.

1. All concrete shall contain five percent (5%), plus or minus one percent (1%) entrained air of evenly dispersed air bubbles at the time of placement. The air-entraining agent shall contain no chloride and conform to ASTM C260, or U.S. Army Corps of Engineers Specifications CRD-C13. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. The Engineer, or Owner and his duly authorized representatives reserve the right, at any time, to sample and test the air-entraining agent or the air content of concrete received on the job by the Contractor. Air entrainment in the concrete shall be tested by ASTM C138, ASTM C231 or ASTM C173. If any sample tested does not have the specified air content, a second test shall be performed. If the second test does not meet the specified air content, the concrete represented by the test shall be removed from the job.

2. A "super plasticizer" water reducing agent may be used at the Contractors option, subject to approval by the Engineer, for concrete in hydraulic structures. The amount of cement in the mix shall not be reduced. The slump may be increased to a maximum of 8-inches. Quantities of admixtures and procedures shall be in accordance with the manufacturers published recommendations. The super plasticizer shall conform to ASTM C494, Type F or G. The admixture shall be a second-generation type, free of chlorides and alkalies, composed of a synthesized sulfonated complex polymer that shall be added to the concrete mixer at the batch plant.

3. Fly ash/pozzolan shall conform to ASTM C618, including the requirements of Table 1A, therein, and the following supplementary requirements:

a. Class F Fly Ash

Loss on ignition, maximum	1%
SO3 content, maximum	3%
Moisture content, maximum	1%
$R = (CaO - 5\%)/(Fe_2O_3)$, maximum	1.5

2.2 CONCRETE CURING MATERIALS

A. Evaporation Retardant: Shall be monomolecular film-forming liquid for application to fresh concrete to prevent rapid drying of the surface.

B. Materials for curing concrete shall conform to the following requirements:

1. Concrete curing compound shall be Protex LR-151 as manufactured by Protex Industries, Denver, CO; Hunt Process Clear ARB as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable. All admixtures, including superplasticizers, shall be included in submittals in the mix proportions.

2. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a normal thickness of 10 mils.

3. Burlap, cotton mats or other covering material for use as concrete curing blanket must be overlapped adequately to ensure 100% coverage at all times, and must not be allowed to become dry at any point during the curing period

4. The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 grams per square centimeter of surface.

C. Evaporation Retarder: Waterborne, monomolecular fil forming, manufactured for application to fresh concrete.

2.3 CONCRETE DESIGN REQUIREMENTS

A. General: The concrete mixes shall be designed to produce a concrete of such consistency and composition so as to obtain maximum density and minimum shrinkage. Mix designs with more than forty-one percent (41%) of sand of the total weight of fine and coarse aggregate shall not be used.

B. All concrete shall contain five percent (5%), plus or minus one percent (1%) entrained air of evenly dispersed air bubbles at the time of placement. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. The Engineer or Owner and his duly authorized representatives reserve the right, at any time, to sample and test the air-entraining agent or the air content of concrete received on the job by the Contractor. Air entrainment in the concrete shall be tested by ASTM C138, ASTM C231 or ASTM C173. If any sample tested does not have the specified air content, a second test shall be performed. If the second test does not meet the specified air content, the concrete represented by the test shall be removed from the job.

C. Water-Cementitious Materials Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall not be less than that specified in the following Table:

Type of Work	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (in.)	Min. Cement W/C per CY (94# sacks)	Maximum w/cm (by wt.)
Slabs on grade, footings, floor slabs, and all other concrete items not specified elsewhere.	4,000	1	6.0	0.50
Site work concrete such as fence posts, thrust blocks, valve collars, etc.	3,000	1	5.0	0.50

D. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

E. At the Contractors option, fly ash/pollozan may be used as a partial cement replacement in concrete as follows:

1. Fly ash shall replace not more than twenty five percent (25%) by weight of the Portland Cement in the design mix. The design mix shall contain a minimum of six (6) sacks of cement per cubic yard before the replacement is made.
2. Fly ash for all structures shall be Class F fly ash.
3. If the coarse or fine aggregates are proven to be potentially alkali-silica reactive per ASTM C227, the mineral admixture Class F fly ash shall be proportioned by weight of cement to provide a fly ash to portland cement ratio not less than 1:4, not less than 20 percent of the total cementitious material. The Contractor shall provide the Engineer with chemical and physical analysis of the fly ash, and detailed design mix to meet the requirements of ASTM C441.

F. A "superplasticizer" (high-range water-reducing) admixture may be used at the Contractor’s option, subject to approval by the Engineer, for concrete in hydraulic structures. The amount of cement in the mix shall not be reduced. The slump may be

increased to a maximum of 9-inches. Quantities of admixtures and procedures shall be in accordance with the manufacturers published recommendations

2.4 CONSISTENCY

A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (inches)
Footings and Slabs	3-inches + 1/2-inches, - 1 inch.
Other Work	3-inches ± 1-inch.
With High Range Water Reducer Added	8-inches maximum.

2.5 TRIAL BATCH AND LABORATORY TESTS

A. Before placing any concrete, the Contractor shall submit the certified trial batch results of each class of concrete having a 28-day strength of 3,500 psi or higher, based on the preliminary concrete mixes submitted by the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractors preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain three (3) drying shrinkage, and six (6) compression test specimens from each batch. The costs for the trial batch tests shall be borne by the Contractor.

B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C192 and ASTM C39. Three (3) compression test cylinders will be tested at 7-days and three (3) at 28-days. The average compressive strength for the three (3) cylinders tested at 28-days for any given trial batch shall not be less than one hundred twenty-five percent (125%) of the specified compressive strength.

C. A standard sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements for ASTM C136. Values shall be given for percent passing each sieve.

2.6 SHRINKAGE LIMITATION

A. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10-inches, fabricated, cured, dried and measured in accordance with ASTM C157 modified as follows: Specimens shall be removed from molds at an age of 23+ hours after trial batching, shall be placed immediately in water at 70 degrees F. ±3 degrees F. for at least thirty (30) minutes, and shall be measured within thirty (30) minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F. ±3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7-days. This length at age 7-days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F. ±3 degrees F. and fifty percent (50%) ±4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21 and 28-days of drying after 7-days of moist curing.

B. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001-inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing during shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be specified herein.

C. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036 percent or 0.042 percent, respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements.

D. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than twenty-five percent (25%).

E. If the required shrinkage limitation is not met during construction, the Contractor shall take all necessary action, at not additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content ratio; washing or aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.7 CEMENT GROUT

A. Cement grout materials shall be as specified in Section 03 60 00 - Grout.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 MIXING CONCRETE

A. Mixing equipment shall be subject to the Engineers approval. Mixers shall be of the stationary plant or truck mixer type. Adequate equipment and facilities shall be provided for accurate measurement and control of all materials and for readily changing the proportions of the material. The mixing equipment shall be maintained in good working order and shall be capable of combining the aggregates, cement and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation. Cement and aggregate shall be proportioned by weight.

B. The batch plant shall be capable of controlling and delivering of all material to within one percent (1%) by weight of the individual material. If bulk cement is used, it shall be

weighed on a separate visible scale that will accurately register the scale load at any stage of the weighing operation from zero to full capacity.

1. Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and an addition of mixing water will not be permitted. Retempering of concrete (addition of water to previously prepared concrete mix) will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturers rated capacity of the mixer.

2. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed. Each mixer shall be equipped with a device for automatically measuring, indicating and controlling the time required for mixing. This device shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.

3. Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C94. After the drum is once started, it shall be revolved continuously until it has completely discharged its batch. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such an increase or decrease.

C. Mixed concrete shall be delivered to the site of the work and discharge shall be completed within one (1) hour after the addition of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F. or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes. The use of non-agitating equipment for transporting concrete will not be permitted.

D. Truck mixers shall be equipped with counters so that the number of revolutions of the drum may be readily verified. The counter must be capable of being reset and shall be actuated at the time of starting mixers at mixing speeds. Concrete shall be mixed in a truck mixer for not less than seventy (70) revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

3.3 PREPARATION OF SURFACES FOR CONCRETING

A. Earth surfaces shall be thoroughly and uniformly wetted by sprinkling prior to the placing of any concrete. These surfaces shall be kept moist by frequent sprinkling up to the time concrete is placed thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.

B. The surfaces of all horizontal construction joints shall be cleaned of all laitance, loose or defective concrete and foreign material. Such cleaning shall be accomplished by

sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

C. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel and preparation off surfaces involved in the placing have been completed and accepted by the Engineer at least four (4) hours before placement of concrete. All reinforcement, anchor bolts, sleeves, inserts and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor. All surfaces of embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

D. All form surfaces in contact with the concrete shall be thoroughly cleaned of all previous concrete, dirt and other surface contaminants prior to use. Damaged form surfaces shall not be used.

1. Wood form surfaces in contact with the concrete shall be coated with an approved release agent prior to form installation. The release agent shall be non-staining and non-toxic after thirty (30) days. Mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface of steel forms.

2. All steel forms shall have the contact surfaces coated with an approved release agent. The release agent shall be effective in preventing discoloration of the concrete from rust and shall be non-toxic after thirty (30) days.

E. Where concrete is to be cast against old existing concrete, the old concrete shall be thoroughly roughened to exposed, hard aggregate by sandblasting or chipping. Any additional surface preparation shall be as called for in the drawings.

F. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or diverted out of the forms and clear of the work. No concrete shall be deposited under water or allowed to rise on any concrete until the concrete has attained its initial set. Pumping or other necessary dewatering operations for removing ground water, if required, shall be the responsibility of the Contractor and will be subject to review by the Engineer.

G. Pipe, conduit, dowels, sleeves and other ferrous items required to be embedded in concrete construction shall be adequately positioned and supported prior to placement of concrete. There shall be a minimum of 2-inches clearance between embedded items and any of the concrete reinforcement. Securing embedments in position by wiring or welding them to the reinforcement will not be permitted.

3.4 PLACING CONCRETE

A. No concrete shall be placed without prior inspection of the forms, reinforcing and embedded items and approval from an authorized representative of the Engineer. The Contractor shall notify he Engineer at least twenty-four (24) hours in advance of any scheduled concrete placement and shall call for final inspections no later than four (4) hours in advance of the scheduled placement. The Contractor shall notify the Engineer at least two (2) hours in advance of setting the opposite side of wall forms so that the construction joint preparation, water stop installation and reinforcing steel inspections can be conducted. It is the Contractors responsibility to see that the forms are properly cleaned and oiled before being set, the construction joints properly prepared, reinforcing steel is securely and

properly supported in the correct position and that all embedment items including electrical conduit is correctly installed before calling for inspections. The Engineer may at his option require the use of placement cords if deemed necessary.

B. Placement of concrete shall conform to the requirements and recommendations of ACI 301, 304 and 318, except as modified herein.

C. Concrete, which upon or before placing is found not to conform to the requirements specified herein, shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these specifications, or which is of inferior quality, shall be removed and replaced at the expense of the Contractor.

D. No concrete shall be placed during rain or snowstorms, unless completely covered to prevent storm water from coming in contact with it. Sufficient protective covering material shall be kept on hand at all times should rain or snowstorms arise during concrete placement operations.

E. Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with vibrator or other means. Concrete shall be uniformly distributed during the placing process and in no case after depositing shall any portion be displaced in the forms more than 2-feet in horizontal direction. Concrete shall be deposited in forms in horizontal layers not to exceed 24-inches in depth and shall be brought up evenly in all parts of the form. The rate of placement of concrete in forms shall not exceed 5-feet of vertical rise per hour. As the concrete is placed it shall be consolidated thoroughly and uniformly by mechanical vibration to secure a dense mass, close bond with reinforcement and other embedded items and smooth surface. The mechanical vibrator shall penetrate not only the freshly placed concrete, but also the previously placed lift to ensure the lifts become monolith. New concrete shall be placed against previously placed concrete, not away from it. When concrete is placed on a slope, placement shall begin at the lower end of the slope and progress to the upper end for the full width of the placement. Consolidation by mechanical vibration shall follow directly behind placement and the rate of placement shall never get ahead of the consolidation crew. Concrete placement shall continue without avoidable interruption, in a continuous operation until the end of the placement is reached.

F. The drop of concrete into slab or wall forms shall be vertical. Concrete shall not be dropped through reinforced steel, but deposited in forms using a hopper with a drop chute to avoid segregation and to keep mortar from coating the reinforcement steel and forms above the in-place concrete. In no case shall the free fall of concrete exceed 4-feet below the end of the hopper or chute.

G. If it takes more than 20-minutes to get back to place concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20-minutes. If concrete is to be placed over previously poured concrete and more than 20-minutes have elapsed, then a layer of grout not less than 1/2-inch thick shall be spread over the surface before placing the additional concrete.

H. The placement of concrete for slabs, beams or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one (1) hour.

I. Concrete shall be placed with the aid of approved mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faced in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18-inches.

1. Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one (1) spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

J. Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired as directed by the Engineer. No defective work shall be patched or repaired without the prior inspection and approval of the Engineer.

K. The temperature of concrete when it is being placed shall be not more than 90 degrees F. nor less than 40 degrees F. in moderate weather, and not less than 50 degrees F. in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F., the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

L. Concrete shall not be placed on a frozen subgrade or subgrade that contains frozen materials. All ice and snow shall be removed from inside forms and from reinforcing steel and embedded items. The temperature of all surfaces that the concrete will contact shall be raised above the freezing point for at least 12-hours prior to placing new concrete.

1. The minimum temperature of fresh concrete as mixed shall be 60 degrees F. for ambient temperature above 30 degrees F.; 65 degrees F. for ambient temperature 0 degrees F. to 30 degrees F.; and 70 degrees F. for ambient temperature below 0 degrees F. The minimum temperature of fresh concrete after placing shall be 55 degrees F. for the first 72-hours.

2. The use of calcium chloride shall not be permitted.

3. In general, the Contractor shall adhere to the recommendations as outlined in ACI Standard 306.1 for cold weather concreting, except as required herein.

3.5 PUMPING OF CONCRETE

A. Pumping of concrete will be permitted only with the Engineer's approval. The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall have a standby pump or crane and concrete bucket on site during pumping to provide assurance the concrete will be placed without cold joints in the event of pumping equipment breakdown. The minimum diameter of the hose (conduits) shall be 4-inches.

Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced. Aluminum conduits for conveying the concrete will not be permitted.

B. Concrete samples for slump and test cylinders will be taken at the discharge end of the pumping conduit.

3.6 ORDER OF PLACING CONCRETE

A. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7-days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two (2) adjacent wall panels have cured at least 14-days.

B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one (1) hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel.

3.7 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets and bringing only a slight excess of water to be exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8,000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.

B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are horizontal, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.

C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred or worked with suitable appliances, tamping bars, shovels or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified with fifteen (15) minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner than causes segregation of its constituents.

3.8 FINISHING CONCRETE SURFACES

A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles and dimensions shown are defined as tolerances and are specified in Paragraph 1.5, herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Unformed Surfaces: After placing and consolidating concrete, all unformed top surfaces of slabs, walls, curbs, gutter and steps, shall be brought to a uniform finished surface. The classes of finish specified for unformed concrete surfaces are defined as follows:

1. Finish U1 (screeded concrete): Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

2. Finish U2 (floated surface): After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating or surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Engineer.

3. Finish U3 (steel trowel finish): After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples and trowel marks. The finish shall be smooth and free of all irregularities.

4. Finish U4 (light broom finish): Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a non-skid finish.

C. The schedule for finished unformed surfaces shall be as follows:

Unformed Concrete Surface Schedule

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material.	U1
Floor slabs to be covered with grouted tile or topping grout and slabs to be covered with built-up roofing.	U2
All building and machine room floors, basin floors not receiving a grout topping, channel floors, top of interior walls, top of interior curbs, steps and walkways.	U3

Exterior walkways, curb, gutter, sidewalk and steps, top of valve or meter vaults, electrical pull boxes and catch basins.	U4

D. Floor Sealer Hardener (Surface Applied):

1. Floor hardener shall be applied where shown or noted on the drawings.

2. Floors to receive hardener shall be cured, cleaned and dry with all work above them completed. Apply zinc and/or magnesium fluosilicate evenly, using three (3) coats, allowing 24-hours between coats.

3. The first coat shall be 1/3 strength, second coat 1/2 strength and third coat shall be 2/3 strength. Each coat shall be applied so as to remain set on the concrete surface for fifteen (15) minutes. If sodium silicate is used, it shall be applied evenly, using three (3) coats, allowing twenty-four (24) hours between coats, and the material shall be applied full strength at the rate of one (1) gallon per 300 square feet. Approved proprietary hardeners shall be applied in conformance with the manufacturers' instruction. After the final coat is completed and dry, surplus hardener shall be removed from the surface by scrubbing and mopping with water.

E. Formed Surfaces: Immediately following the removal of forms, the concrete shall be inspected for defects such as rock pockets, grout loss, damage from stripping forms, surface defects such as fins, offsets, bulges, excessive bug-holes and stains. All defective concrete work shall be removed and replaced or repaired to the satisfaction of the Engineer. Any work which has not been constructed in accordance with the plans and specifications will be considered defective.

Correction of defective work shall be as directed by the Engineer and specified herein. No defective work shall be patched, repaired or covered without prior inspection and approval of the Engineer.

Holes left by tie-rod cones or taper ties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-metallic grout.

The classes of formed concrete surfaces are defined as follows:

1. Finish F1: No special treatment is required after form removal except for curing, repair of defective concrete treatment of surface defects, removal of fins and projections, filling of tie holes and filling of depressions and bug-holes 3/8-inch or larger in width or depth with mortar.

2. Finish F2: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth, filling of tie holes and filling of depressions and bug-holes 1/4-inch or larger in width or depth with mortar.

3. Finish F3: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth and tie holes filled with grout. The entire surface shall then receive a light stoning or grinding using a No. 50 or No. 60 grit carborundum stone or grinding wheel to remove any laitance and curing film and to open up bug-holes hidden beneath the thin surface grout film. The surface shall then be given a stoned-sand type architectural finish as follows:

   a. The concrete surface shall be pre-wet for several hours or overnight before treatment.

b. While the surface is still damp, spread a sand mix, consisting of one (1) part of the appropriate Type of Cement and one to one and a half (1 to 1-1/2) parts of fine sand passing the No. 70 screen mixed with enough water and an emulsified bonding agent to have the consistency of thick cream. The sand mix should be spread thinly over the damp surface with a rubber float and rubbed in over the entire area leaving only a minimum amount of material on the surface necessary to produce a sand texture, approximately 1/32-inch in thickness.

c. The surface shall be kept continually damp for seventy-two (72) hours following this finish treatment.

F. The schedule for formed surface finish shall be as follows:

Formed Concrete Surface Schedule

Area	Finish
Formed concrete surfaces to be covered by backfill or coated with below grade waterproofing systems.	F1
Formed concrete surfaces in water channels, below water surface of basins, inside meter and valve vaults, inside cells of hydraulic splitter boxes and weirs.	F2
Formed concrete surfaces inside buildings and machine rooms and all exposed exterior surfaces of foundations, basins, vaults, hydraulic structures and curbs.	F3

3.9 CURING AND DAMPPROOFING

A. General: All concrete shall be cured for not less than ten (10) days in warm to hot weather and fourteen (14) days in cold weather after placing, unless otherwise indicated by the Engineer, in accordance with the methods specified herein for the different parts of the Work, and described in detail as follows:

1. Water Curing: Keep the concrete structures thoroughly and continuously wet and covered for at least 7 days. Place and anchor covers, mats, and sheeting to ensure continuous contact with the concrete surfaces. Use one of the water curing methods as detailed in ACI 308.1.

2. Curing Compound: The surface shall be sprayed with a liquid membrane-forming curing compound applied in accordance with the manufacturers printed instructions.

a. Care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

b. Curing compound specified shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within one (1) hour after removal of forms from contact with formed surfaces. Repairs to formed surfaces shall be made within the said one (1) hour period. If repairs cannot be made with the one (1) hour period they shall

be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

3. Cold weather is defined as when the temperature reaches or goes below 35 degrees F. for one (1) hour during any 24-hour period during the curing period.

B. Method 2 shall be used for wall sections with forms removed, encasement concrete and all concrete surfaces where Method 1 is not feasible.

3.10 PROTECTION

A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damage to finish surfaces.

B. Finished floor slabs in buildings and machine rooms shall be suitably protected from wear or damage from construction operations. The Contractor shall not use newly finished floors or buildings for machine assembly, fabrication, pipefitting, curing or welding operations without covering the working area with plastic sheets and/or plywood. Any concrete found to be damaged or which may have been originally defective or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.

C. Immediately following the first frost in the fall, the Contractor shall be prepared to protect all concrete against freezing.

3.11 CURING IN COLD WEATHER

A. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be protected against freezing temperatures for not less than forty-eight (48) hours after it is placed. After the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be maintained at a temperature not lower than 50 degrees F. for at least seventy-two (72) hours after it is placed.

B. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F. over a (3) three day duration.

C. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected from drying and excessive carbon dioxide atmosphere by application of curing Method 2 or Method 3, as specified under Article 3.9, Paragraph A herein.

3.12 REPAIR OF DEFECTIVE CONCRETE

A. No concrete repairs shall be made until after inspection and approval of the method of repair by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing extensive voids, holes, honeycombing or similar depression

defects shall be completely removed and replaced. Concrete containing minor voids, holes, honeycombing or similar depression defects shall be repaired as specified herein. All concrete repairs and replacements shall be promptly executed by the Contractor at its own expense.

B. The repair of holes left by rock pockets, penetrations, tie rods or other reasons will require the use of non-shrink, non-metallic grout material.

END OF SECTION

SECTION 03 60 00

GROUT

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish, place, finish and cure the following types of grouting mortars as called for herein and as shown in the Contract Documents.

1. Non-Shrink Grout: This type of grout shall be used wherever grout is shown or called for in the Contract Documents, unless another type is specifically referenced.

2. Topping Grout: This type of grout shall be used for grouting in submerged applications, such as clarifier bottoms.

3. Epoxy Grout: This type of grout shall be used for anchor bolt or reinforcing steel embedment, repairs and resurfacing.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

2. ACI 318 - Building Code Requirements for Structural Concrete.

B. American Society of Testing and Materials:

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM C109 - Standard Test Method for Compressive (Latest Edition) Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens).

3. ASTM C150 - Standard Specification for Portland Cement.

4. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

C. U. S. Army Corps of Engineers Concrete Research Division (CRD):

1. CRD C621 - Non-Shrink Grout.

1.3 SUBMITTALS

A. Non-Shrink Grout: Submit manufacturers' technical data including compressive strength and expansion data at plastic, flowable and fluid consistencies. Also submit manufacturer's applications manual containing instructions and recommendations for mixing, handling, placement and appropriate uses for each type of non-shrink grout used in the work.

B. Topping Grout: Provide certified mix design including proportions and gradations of all materials and compressive strength test results from at least one (1) trial batch. Tests shall

be performed by a certified testing laboratory. All costs for such mix design and trial batch tests shall be borne by the Contractor.

C. Epoxy Grout: Submit manufacturers' technical data including strengths and application manual of instructions for mixing, handling and placing.

1.4 QUALITY ASSURANCE

A. Mix design tests for topping grout shall be performed per the standards referenced herein.

B. During the progress of construction, the Engineer may have tests made of each type of grout used in the work to ensure compliance with the Contract Documents. These tests will be made in accordance with the standards referenced herein. The test expense during construction, except for the mix design and trial batch tests, will be borne by the Owner. The costs of additional tests including non-destructive tests and core drilling needed to verify or investigate the quality of questionable work or material shall be borne by the Contractor.

C. Grout for testing shall be supplied by the Contractor at no cost to the Owner.

D. If any grout fails to meet the requirements of these specifications, immediate corrective action shall be taken for all subsequent batches. Grout already in place that fails to meet these requirements is subject to removal and replacement with all costs borne by the Contractor.

E. Construction tolerances shall be as specified in Section 03 30 00 - Cast-In-Place Concrete, except as modified herein and elsewhere in the Contract Documents.

PART 2 PRODUCTS

2.1 NON-SHRINK GROUT

A. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged.

B. Non-shrink grouts for use as herein specified shall conform to the Corps of Engineers specifications for Non-Shrink Grout, CRD-C621-85 and to these specifications. The grout shall have a 28-day compressive strength of 6,000 psi or greater.

C. Non-shrink grouts shall be as manufactured by: Tremcrete Systems Inc., Woodland, California; Gifford-Hill & Company, Inc., Dallas, Texas; or approved equal.

2.2 TOPPING GROUT

A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated herein. All materials and procedures specified for concrete in Section 03 30 00 shall apply except as indicated otherwise herein.

B. Topping grout and concrete fill shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, structural concrete as indicated in Section 03 30 00 may be used when accepted by the Engineer.

C. Coarse aggregate shall be graded as follows:

U.S. STANDARD SIEVE SIZE	PERCENT BY WEIGHT PASSING
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.

E. Strength: Minimum compressive strength at 28-days shall be 4,000 psi.

2.3 EPOXY GROUT

A. Epoxy grout shall be a pourable, non-shrink, one-hundred percent (100%) solids system. The epoxy grout system shall have three components; resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

B. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F. The epoxy grout shall develop a minimum compressive strength of 5,000 psi in 24-hours and 10,000 psi in 7-days.

2.4 CEMENT GROUT

A. Portland Cement: ASTM C150, Type I and II.

B. Water:

1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:

a. Corrosion of steel.

b. Volume change increasing shrinkage cracking.

c. Efflorescence.

d. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.

2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.

3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2. Water content shall be such that the grout can be readily spread, yet not wet enough to cause trouble with surface water or laitance, or failure to stay in place after screeding. All grout mixes and mixing procedures shall be submitted in accordance with Section 01 00 00 - Contractor Submittals, and shall be subject to review and approval by the Engineer prior to commencing the grouting operations.

E. The minimum compressive strength at 28 days shall be 4000 psi.

F. Procedures for Grout placement shall be approved by the equipment supplier, to insure that no equipment is overstressed, as well as proper placement tolerances. Equipment Supplier shall have final say on grouting procedures and final tolerances.

2.5 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as required for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 CURING MATERIALS

A. Curing materials shall be as specified in Section 03 30 00 - Cast-In-Place Concrete, for cement topping grout and as recommended by the manufacturer of non-shrink grouts.

PART 3 EXECUTION

3.1 PREPARATION

A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03 30 00. The finish of the grout surface shall match that of the adjacent concrete

B. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

C. Rough concrete lightly, but not enough to interfere with placement of grout.

D. Remove foreign materials from metal surfaces in contact with grout.

E. Align, level and maintain final positioning of components to be grouted.

F. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.2 PLACING NON-SHRINK AND EPOXY GROUT

A. All forming, mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Place grout material quickly and continuously.

C. Do not use pneumatic-pressure or dry-packing methods.

D. Apply grout from one side only to avoid entrapping air.

E. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.

F. Thoroughly compact final installation and eliminate air pockets.

G. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.3 PLACING TOPPING GROUT

A. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.

B. The minimum thickness of grout topping and concrete fill shall be one inch, unless otherwise indicated on the Design Drawings. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.

C. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping or fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

D. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

E. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.4 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

3.5 CURING

A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. After grout has attained its initial set, keep damp for minimum of 7 days, or as otherwise indicated by the manufacturer.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section includes split face and smooth face concrete masonry units; fire brick and reinforcement, anchorage, and accessories.

B. The Contractor shall furnish all materials and construct the brick masonry work for the project, complete, including the furnishing, fabrication and placing of reinforcing steel, clips, ties, anchors and the setting of embedded items all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. The International Building Code, as referenced herein, shall be the most recent New Mexico Construction Industries Division (CID) adopted edition of International Building Code (IBC).

B. American Society for Testing and Materials (ASTM)

1. ASTM A82 - Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
2. ASTM A615 - Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM C55 - Standard Specification for Concrete Building Brick.
4. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
5. ASTM C144 - Standard Specification for Aggregates for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C207 - Standard Specification for Hydrated Lime for Masonry.
8. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
9. ASTM C404 - Standard Specifications for Aggregates for Masonry Grout.

1.3 CONTRACTOR SUBMITTALS

A. Submit full-sized samples of concrete masonry units of each type, color and texture required. Also submit certification that the product meets ASTM C90, Type I moisture controlled, Grade N units.

B. Submit color chart for mortar.

C. The Contractor shall prepare in accordance with IBC Section 2105a set of five (5) masonry prisms using a representative test batch of mortar and masonry materials to be used in the structure. These prisms shall be tested by a certified testing laboratory. Samples of the trial batch mortar used in preparing the prisms shall also be taken in accordance with IBC Section 2105 and tested by a certified testing laboratory. The prism

and mortar test reports shall be submitted to the Engineer prior to beginning masonry construction. All costs for these preliminary tests shall be paid for by the Contractor, and reimbursed from the Testing Allowance.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with MSJC Code (ACI 530/ASCE 5/TMS 402) and MSJC Specification (ACI 530.1/ASCE 6/TMS 602).

B. The size, color and texture of the masonry units shall be as specified herein under Part 2, Products. The color of the mortar shall be determined in the field, prior to construction, as best matches masonry and approved by the Engineer.

C. During construction, a set of three (3) masonry prisms shall be built and tested in accordance with IBC Section 2105 for each 5,000 square feet of wall area, but not less than one (1) set of three (3) masonry prisms per individual structure. The costs of sampling, testing and test reports shall be paid for by the Contractor, and reimbursed from the Testing Allowance. The compressive strength of masonry determined in accordance with IBC Section 2105 for each set of prisms shall equal or exceed the minimum strengths specified herein.

D. During masonry construction, filling grout shall be sampled and tested in accordance with IBC Section 2105. The following schedule shall be followed:

1. During grouting operations one (1) test shall be taken per lift. The tests shall consist of three (3) specimens which are made in accordance with IBC Section 2105. Grout compressive strength shall equal or exceed the minimum strengths specified herein.

E. All prism, mortar and grout testing shall be performed by a certified testing laboratory that shall be subject to the approval of the Engineer. All costs of sampling, testing and reporting shall be paid for by the Contractor, and reimbursed from the Testing Allowance. Additional tests requested by the Engineer will be paid for by the Owner, except that tests indicating non-compliance with the Contract Documents shall be paid for by the Contractor.

F. Masonry construction shall be inspected in accordance to IBC Section 1704 by an approved agency as described in Section 1704.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Hot and Cold Weather Requirements: MSJC Specification.

PART 2 PRODUCTS

2.1 UNIT MASONRY ASSEMBLIES

A. Concrete Brick Units: Split face, as shown on Drawings, ASTM C55, Grade N, Type I, normal weight, Color TBD by Owner.

B. The minimum masonry assemblage compressive strength, f'm, at age of 28 days shall be 1500 psi.

C. Integrally colored to match Engineer's sample for walls on exterior of building.

D. Concrete Masonry Unit Size and Shape: Nominal modular size of 8 x 16 x 8 inches. Furnish special units for 90 degree corners, bond beams, and lintels.

2.2 ACCESSORIES

A. Reinforcing steel and metal accessories for all reinforced hollow clay masonry:

1. Reinforcing bars: Grade 60, conforming to the requirements of ASTM A615-86 for deformed billet steel for concrete reinforcement.

2. Joint reinforcement manufactured with wire conforming to IBC Section 2105 Joint reinforcement wire formed from wire that has been zinc coated in accordance with the referenced standards, Class I.

B. Mortar: Type S Portland Cement Lime bay proportion with a minimum 28-day 1500 psi. The color of mortar to match adjacent CMU color as selected by Engineer from manufacturer's full range of colors.

C. Grout: Minimum 28-day compressive strength of 2000 psi. Proportions shall be one (1) part Portland Cement, two to three (2-3) parts sand, and not more than one (1) part pea gravel. Grout shall have a slump of 9-inches plus or minus 1-inch. Transit-mixed grout may be used and shall be continually rotated at idle speed from the time the water is added until the grout is discharged.

2.3 MISCELLANEOUS MATERIALS

A. Portland Cement shall be Type I or II, low alkali, conforming to IBC Section 2103 (ASTM C90). Masonry cements or plastic cements will not be permitted.

B. Hydrated lime shall be Type N conforming to IBC Section 2103.

C. Mortar aggregates shall conform to IBC Section 2103 (ASTM C270). Grout aggregate shall conform to Section 2103 (ASTM C404).

D. Water for mixing into mortar or grout shall be clear, potable water.

E. Admixtures other than coloring for use in mortar and grout shall not be used unless approved by the engineer. Coloring admixture for mortar shall be pure mineral oxide pigments delivered in sealed packages providing accurate measured amounts for uniform mix proportioning and color shall be approved by the Engineer.

F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials, recommended by masonry unit manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive Work.

B. All masonry work shall be performed only under weather conditions and in conformance with IBC Section 2104 and subject to the approval of the Engineer.

3.2 PREPARATION

A. Coordinate placement of anchors supplied by other sections.

B. Prior to laying the first course of masonry, the concrete foundation surface shall be clean and free of latence, loose aggregate, grease and curing materials. This surface preparation shall be accomplished by sandblasting or high pressure washing. The surface shall be rough to provide a good bond between foundation concrete, mortar and grout.

C. The foundation shall be sufficiently level such that the bed joint thickness is not less than 1/4-inch nor more than 5/8-inch. The foundation face shall be sufficiently true to line so that the masonry face projects no more than 1/4-inch.

3.3 MATERIAL HANDLING, STORAGE AND PREPARATION

A. Cement, lime and other calcareous materials delivered to the site shall be properly stored and protected from the weather in unbroken bags, barrels or other approved containers which are plainly marked and labeled with the manufacturers' names and brands. Materials shall be stored and handled in a manner which will prevent the intrusion of foreign materials and damage by water or dampness.

B. Masonry units shall be handled with care to avoid chipping and breakage and shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used. Materials stored on newly constructed floors shall be stacked in such a manner that the uniformly-distributed loading does not exceed 30 psf.

C. Reinforcing steel and all embedded items shall be stored off the ground and shall be protected from mud, oil, concrete, mortar, grout and weather conditions that will cause excessive rusting.

3.4 INSTALLATION

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

B. Coursing of Concrete Masonry Units:

1. Bond: Running.

2. Coursing: One unit and one mortar joint to equal eight [8] inches.

3. Mortar Joints: Concave.

C. Placing and Bonding:

1. Masonry units shall be placed in the pattern and per the details called for on the Drawings. All work shall be plumb, level and true to line with all corners and angles square unless otherwise indicated on the Drawings. Interlock intersections and external corners.

2. Isolate masonry partitions from vertical structural framing members with movement joint as indicated on Drawings.

3. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

4. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges.

5. Vertical and horizontal mortar joints shall be 3/8-inch and tooled to a concave pattern.

D. Set or embed all required anchors, bolts, reglets, sleeves, conduits and other items as called for in the Drawings. Protect all adjoining work including door jams and corners from damage or disturbance during the masonry work. Protect all sills, ledges and offsets from droppings of mortar.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

F. Reinforcing Steel:

1. Reinforcement bar details to conform to ACI 530/ASCE 5-05/TMS 402 and placed as shown on the Drawings. All dowels shall be in proper location prior to start of the work. Secure reinforcing bars in their proper position.

2. Horizontal joint reinforcement to conform to ACI 530/ASCE 5-05/TMS 402 and placed as shown on the Drawings.

3. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum of 16 inches on each side of opening. Place joint reinforcement continuous in first and second joint below top of walls. Lap joint reinforcement ends minimum of 6 inches.

G. Grouting:

1. Grouting operations and conditions to conform to ACI 530 Section 3.5. Only low lift grouting to a maximum height of 5-feet will be permitted during any twenty-four (24) hour period.

2. Grout placed in a continuous pour, consolidated by puddling or mechanical vibrating during placing, and reconsolidated after excess moisture has been absorbed, but before plasticity has been lost.

H. Pointing and Cleaning:

1. At the completion of the work all holes or defective mortar joints in exposed masonry shall be pointed. Defective joints shall be cut out and repointed.

2. Exposed masonry shall be protected against staining from wall grouting or other sources and excess mortar shall be cleaned off the surfaces as the work progresses.

3. At the completion of the work, all exposed masonry shall be cleaned using a dilute acid solution.

4. All waste and surplus masonry materials shall be removed from the job and all stains or dirt from this operation affecting adjacent surfaces shall be removed by an approved cleaning method.

I. Masonry Flashings:

1. Extend flashings horizontally through outer wythe at foundation walls, above ledge or shelf angles and lintels, under parapet caps, at bottom of walls, and turn down on outside face to form drip.
2. Turn flashing up minimum eight [8] inches and bed into mortar joint of masonry seal to concrete or seal to sheathing over wood framed back-up.
3. Lap end joints and seal watertight.
4. Turn flashing, fold, and seal at corners, bends, and interruptions.

J. Lintels:

1. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled or indicated.
2. Maintain minimum six [6] inches bearing on each side of opening.

K. Grouted Components:

1. Reinforce bond beam and pilasters as detailed.
2. Support and secure reinforcing bars from displacement.
3. Place and consolidate grout fill without displacing reinforcing.
4. At bearing locations, fill masonry cores with grout for minimum twelve [12] inches both sides of opening.

L. Control and Expansion Joints:

1. Do not continue horizontal joint reinforcement through control and expansion joints.
2. Form control joint with sheet building paper bond breaker fitted to one side of hollow contour end of block unit. Fill resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

M. Built-In Work:

1. As work progresses, install built-in metal door and frames, window frames, anchor bolts, plates, and other items to be built in the work furnished by other sections.
2. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum twelve [12] inches from framed openings.

N. Cutting and Fitting:

1. Cut and fit for chases, pipes, conduit, sleeves, grounds, etc. Coordinate with other sections of work to provide correct size, shape, and location.

O. Cleaning

1. Remove excess mortar and mortar smears as work progresses.
2. Clean soiled surfaces with cleaning solution.

P. Tolerances

1. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
2. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section includes wall, and roof framing; built-up structural members; shop fabricated trusses; wall and roof sheathing; preservative and fire retardant treatment, sill gaskets, flashings; and roof curbs and cants; blocking in wall and roof openings; wood furring and grounds; electrical panel back boards, concealed wood blocking.

1.2 SUBMITTALS

A. Shop Drawings: Indicate framing system, loads and cambers, bearing details, and framed openings.

B. Manufacturer's catalogs showing rough hardware conforming to or equivalent to hardware shown.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by NIST PS 20.

2. Plywood Grading Agency: Certified by APA/The Engineered Wood Association.

B. Conform to IBC for loads, seismic zoning and other governing load criteria unless more stringent requirements are contained in these specifications or shown in the Drawings.

C. Prefabricated wood trusses shall be designed by or under the direct supervision of a Professional Engineer registered in the State of New Mexico and experienced in the structural design of wood trusses of the type used in this project.

D. Standard framing and spacing shall be used per applicable code requirements.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

A. Lumber Grading Rules: Lumber shall be graded in accordance with the "Standard Grading and Dressing Rules No. 16", of the West Coast Lumber Inspection Bureau (WCLIB) or in accordance with "Grading Rules for Western Lumber", published by Western Wood Products Association, as specified herein.

B. Grade Marking: Each piece of lumber shall bear the official grade mark of recognized grading agencies, using one of the above-mentioned grading rules.

C. Size Dressing: All lumber, except as otherwise shown or specified herein, shall be dressed to size in accordance with the standards of the association under which the lumber is graded. All lumber shall be S4S unless otherwise shown.

D. Drying: All lumber incorporated in the work, except where otherwise specified, shall be air or kiln dried to a moisture content of not more than 19% and not less than 1%.

E. All wood nailing blocks, sills and plates resting on or embedded in concrete or masonry within 18-inches of grade shall be pressure-treated in accordance with American Wood Preservers' Association Manual of Recommended Practice, Standard for Preservative Treatment by Pressure Process-All Timber Products, Cl. Preservative shall conform to American Wood Preservers Assn. and American Wood Preserves Bureau Standard Specifications referenced in Paragraph entitled, "References Specifications, Codes and Standards". Creosote shall not be used.

F. Wherever necessary to cut, notch, dap, drill or frame treated lumber, newly cut or bored surfaces shall be treated with two heavy coats of the same preservative used in the original treatment. The minimum penetration depth shall be 1/4-inch.

2.2 SHEATHING MATERIALS

A. Plywood Roof and Wall Sheathing: Plywood shall conform to the requirements of U. S. Product Standard PS 1, as specified herein. All plywood panels shall be marked with grade mark of the American Plywood Association. The mark shall identify the plywood as to species, glue type and grade in compliance with the applicable commercial standard. Except as otherwise specified below or shown, plywood shall be Douglas Fir, Exterior, C-D, SlS.

B. Telephone and Electrical Panel Boards: Plywood.

2.3 SHOP FABRICATED TRUSSES

A. Except where more restrictive requirements are shown on the Drawings, listed below or contained in the local building code, metal-plate-connected wood roof trusses are to be designed in accordance with the applicable provisions of the latest edition or revision of "Design Specification for Metal-Plate-Connected Wood Trusses", published by the Truss Plate Institute.

B. Manufacturers:

1. J.D. Adams Company
2. Alpine Engineered Products, Inc.
3. Gang-Nail Systems, Inc.
4. Hydro-Air Engineering, Inc.
5. Champion Truss, Inc.
6. Substitutions: Permitted if approved by Engineer.

C. Design Loads: Per structural calculations package and general notes of contract drawings.

D. Deflections: Per building code and referenced standards.

E. Truss Type: Plate connected.

F. Verify dimensions and site conditions prior to fabrication.

G. Fabricate steel connector plates to size, configuration and thickness required to properly transfer member loads.

H. Cut members accurately to length to achieve tight joint connections.

I. Jig trusses during fabrication to assure accurate configuration.

J. Press connectors into lumber, both sides of joint simultaneously.

2.4 ACCESSORIES

A. Fasteners: Galvanized steel for exterior, high humidity, and treated wood locations, plain finish elsewhere.

B. Die Stamped Connectors: Minimum 20 gauge (0.036 inches thick), galvanized steel.

C. Structural Framing Connectors: Galvanized steel, sized to suit framing conditions.

D. Rough Hardware: The term "rough hardware" shall include nails, screws, lag screws, bolts, nuts, washers, plates, metal fasteners and framing anchors; anchor bolts which are to be embedded into concrete, concrete masonry or brick masonry; and similar items employed in erection and construction of the rough carpentry work. Rough hardware shall be of standard manufacture, approved by a recognized agency for the intended applications and shall be provided with laboratory test results on capabilities when requested by the Engineer. All hardware items shall be steel unless specified or shown otherwise.

E. Building Paper: ASTM D226 No. 15 asphalt felt.

PART 3 EXECUTION

3.1 FRAMING

A. Erect wood framing members in accordance with applicable code. Place members level and plumb. Place horizontal members crown side up.

B. Rough carpentry shall be as shown, specified and as necessary to complete work. The Contractor shall verify drawing dimensions with actual field conditions and shall inspect related work and adjacent surfaces and shall report to the Engineer all conditions that could prevent proper execution of this work.

C. Timber connectors and installation thereof shall conform to applicable requirements of AITC 104 and AITC 105 of the Timber Construction Manual of the American Institute of Timber Construction.

D. Strength Considerations: Structural wood framing member shall not be spliced between bearing points or supports. Place framing so that structural and other important members do not require cutting for openings, pipes, vents, conduits or ducts. Bearing surfaces on which wood structural members are to rest shall be finished to give full, true and even support. Wedges or shims shall not be used to correct faulty work. Wood members, which have been split or otherwise damaged to such an extent as to impair their strength, shall be removed and replaced. Members shall not be cut, notched nor bored more than 1/4 of their depth without adequate and approved reinforcing.

E. Blocking and Backing: All blocking and backing in walls and ceilings shall be nominal 2-inch thick material of a depth as needed and shall be accurately located around light fixtures, ceiling register, grilles and other required mechanical and electrical items. The blocking shall fit snugly and shall be spiked into the supporting framing members. Wood blocking (backing) to receive sheathing, siding, metal lath and gypsum board shall be provided wherever necessary for securing the facing materials.

F. Place full width continuous termite shield and sill flashing on foundations.

G. Place sill gasket directly on sill flashing.

H. Frame double joist headers at ceiling openings. Frame rigidly into joists. Frame double joists under wall studding.

I. Bridge framing in excess of 8 feet span at mid-span members. Fit solid blocking at ends of members.

J. Curb roof openings except where curbs are provided. Construct curb members of single pieces for each side.

3.2 SHEATHING

A. Secure wall sheathing with ends staggered, over firm bearing.

B. Place building paper over wall sheathing, weather lap joints and end laps, staple in place.

C. Install electrical panel backboards with plywood sheathing material where required. Size backboard by 12 inches beyond size of electrical panel.

3.3 SHOP FABRICATED TRUSSES

A. Verify that supports and openings are ready to receive trusses.

B. Verify that sufficient end bearing area exists.

C. Install trusses in accordance with the applicable provisions of "Commentary and Recommendations for Handling and Erecting Wood Trusses" of the Truss Plate Institute.

D. After trusses have been placed leveled, aligned and plumbed and temporary bracing is in place, reset, in accordance with manufacturer's directions, any connection plates that may have been loosened.

E. Bracing:

1. Before applying any superimposed loads, place permanent bridging, bracing and anchors.

2. Unless other bracing is shown on the Drawings, provide bracing in accordance with the applicable provisions of "Bracing Wood Trusses: Commentary and Recommendations" of the Truss Plate Institute.

F. Do not field-cut trusses or remove any truss members.

G. Place headers and supports to frame openings required.

H. If, in the opinion of the Engineer, any damaged trusses cannot be satisfactorily repaired, the damaged trusses shall be removed from the project and replaced with trusses acceptable to the Engineer.

3.4 SITE APPLIED WOOD TREATMENT

A. Treat site-sawn cuts. Brush apply two coats of preservative treatment on untreated wood in contact with cementitous materials and roofing and related metal flashings.

B. Allow preservative to cure prior to erecting members.

END OF SECTION

SECTION 08 11 13

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes steel doors, panels, hinges, closers, thresholds and frames.

B. Related Sections:

1. Section 08 71 00 Door Hardware

1.2 REFERENCES

A. ANSI A156.1 – Butts and Hinges

B. ANSI A156.18 – Materials and Finishes

C. ANSI 250.8 - Recommended Specifications for Standard Steel Doors and Frames.

D. ANSI A250.10 – Test procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

E. ASTM A653/A653 M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot Dip Process

F. ASTM C1363 – Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

1.3 SUBMITTALS

A. Product Data: Submit door and frame configurations, location of cut-outs for hardware reinforcement.

B. Samples: Submit two samples of metal, door frame and door face illustrating shop finish colors and surface texture.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following:

1. ANSI 250.8 - Recommended Specifications for Standard Steel Doors and Frames.

2. DHI - Door Hardware Institute - The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware.

3. Fire Rated Doors, Panels and Frames:

a. Product Construction: NFPA 252 – Standard Methods of Fire Tests of Door Assemblies.

b. Product Installation: NFPA 80 – Standard for Fire Doors and Other Opening Protectives.

PART 2 PRODUCTS

2.1 STEEL DOORS AND FRAMES

A. Manufacturers:

1. Amweld Building Products, Inc.
2. Ceco Door Products.
3. SW Fleming Limited.
4. Habersham Metal Products.
5. Kewanee Corp.
6. Steelcraft.
7. Substitutions: Permitted.

B. Product Description: Standard shop fabricated steel doors, and frames; fire rated and non-rated types; flush face or stile and rail design.

2.2 COMPONENTS

A. Exterior Doors (Insulated): ANSI A250.8, 1-3/4 inch thick.

1. Level 1 - Standard Duty, Model 2, seamless design.

B. Exterior Frames:

1. Level 1 for Door Models, nominal 18 gage/0.042 inch thick material, base metal thickness.

C. Door Core: Polystyrene foam.

D. End Closure: Channel, 0.04 inch thick, flush.

E. Thermal Insulated Door: Total insulation R-Value of 7, measured in accordance with ASTM C1363.

2.3 ACCESSORIES

A. Removable Stops: Rolled steel channel shape. Primer: ANSI A250.10 rust inhibitive type.

B. Heavy Duty Hinges: ANSI A156.1, full mortise type, complying with following general requirements unless otherwise scheduled.

1. Widths: Sufficient to clear trim projection when door swings 180 degrees.
2. Number: Furnish minimum three hinges to 90 inches high, four hinges to 120 inches high for each door leaf.
    a. Fire Rated Doors to 86 inches High: Minimum three hinges.
    b. Residential Hollow Core Wood Doors: Furnish minimum two hinges.
3. Size and Weight: 4-1/2 inch heavy weight typical for 1-3/4 inch doors.
    a. Doors over 40 inches Wide: Extra heavy weight ball or oilite bearing hinges.

b. Doors 1-3/8 inch Thick: 3-1/2 inch size.

c. Doors 2 inch Thick: 5 inch extra heavy weight ball or oilite bearing.

d. Doors over 48 inches Wide: 5 inch extra heavy weight ball or oilite bearing.

4. Pins: Furnish nonferrous hinges with non-removable pins (NRP) at exterior and locked outswinging doors, non-rising pins at interior doors.

C. Weatherstripping: Resilient vinyl set in aluminum retainer.

D. Heavy duty cane bolt and gate stop assembly to hold open doors:

1. 5/8” diameter, 36” long, black steel cane bolt.

a. Bolt must be able to be kept in the ‘up/unengaged’ position, such that operator need not hold the bolt up as door is opened or closed.

2. Minimum 6” throw, or more to allow full engagement with the gate stop set into concrete porch or driveway.

3. Gate stop shall be a field type gate center stop (set in concrete porch or driveway), part number HS 015 913-34 (custom) as by Hardware Specialties of Albuquerque, OAE

a. 3”x5” rectangular cold-plate steel formed with 7/8” wide by 1” deep at center concave channel.

b. 5/8” diameter, 5” long cold rolled steel bar affixed to bottom center of plate.

E. Closers: ANSI A156.4 modern type with cover closers; full rack and pinion type with steel spring and non-freezing hydraulic fluid; closers required for fire rated doors unless otherwise indicated.

1. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.

2. Arms: Type to suit individual condition; parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.

3. Location: Mount closers on inside of exterior doors, room side of interior doors typical; mount on pull side of other doors.

4. Operating Pressure: Maximum operating pressure as follows.

a. Interior Doors: Maximum 5 pounds.

b. Exterior Doors: Maximum 8.5 pound.

c. Fire Rated Doors: As required for fire rating, maximum 15 pounds.

F. Door Controls and Overhead Holders: Furnish with accessories as required for complete operational installation.

1. Manual Door Holders and Overhead Stops: ANSI A156.8, Grade 1 types as specified.

2.4 FABRICATION

A. Fabricate doors and frames with hardware reinforcement welded in place.

B. Attach astragal to fire rated doors.

C. Configure exterior frames and doors with profile to receive recessed weatherstripping.

D. Fabricate frames as face welded units.

E. Fabricate frames to suit masonry wall coursing with 4 inches head member.

F. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

G. Prepare interior frames for silencers and install.

H. Frame Mullions for Double Doors: Removable type, with profile matching jambs.

I. Frame Transom Bars: Fixed type, with profile matching jamb and head.

J. Attach fire rating label to each fire rated door and frame.

2.5 FINISHES

A. Provide shop-applied primer after fabrication:

1. Prior to shop painting, surfaces shall be cleaned with solvents to remove any grease or oil, and with power wire-brushing or sandblasting to remove loose rust, loose mill scale and other foreign substances.

2. Primer: Rust inhibitive paint suitable as a base for finish coating.

B. Door manufacturer shall provide finish powder coating of the surfaces of the door prior to shipment, per coating manufacturer's instructions, color to be selected by Owner.

C. Steel Sheet: Shop finished galvanized to ASTM A653/A653M A40.

D. Finishes: ANSI A156.18; furnish following finishes unless otherwise noted.

1. Hinges:

a. BHMA 630 and 626, satin finish.

2. Typical Exterior Exposed and High Use Interior Door Hardware:

a. BHMA 630, satin finished stainless steel.

3. Typical Interior Door Hardware:

a. BHMA 626, satin chromium plated brass or bronze.

4. Closers: Finish appearance to match door hardware on same face of door.

a. BHMA 628, satin aluminum, clear anodized.

5. Thresholds: Finish appearance to match door hardware on exterior face of door.

a. BHMA 628, satin aluminum, clear anodized.

6. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install doors and frames in accordance with ANSI A250.8.

B. Mounting Heights from Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated. Coordinate with Section 08 71 00.

1. Top Hinge: Jamb manufacturer's standard, but not greater than 10 inches from head of frame to center line of hinge.

2. Bottom Hinge: Jamb manufacturer's standard, but not greater than 12-1/2 inches from floor to center line of hinge.

3. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.

4. Hinge Mortise on Door Leaf: 1/4 inch to 5/16 inch from stop side of door.

C. Coordinate door frames with masonry wall construction for frame anchor placement.

D. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

E. Install door louvers plumb and level.

F. Finish/Coating:

1. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

2. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

3. Door manufacturer shall provide finish powder coating of the surfaces of the door prior to shipment, per coating manufacturer's instructions, color to be selected by Owner.

G. Adjust door and hardware for smooth and balanced door movement.

H. Cane bolt and gate stop assembly to hold open doors:

1. Cane bolts must be factory welded to doors for pre-fabricated buildings.

2. If cane bolt assembly welded to door in field, touch-up paint and door finish as needed after welding.

3. Weld cane bolt assembly to steel door so as to allow 6" of throw, or more if needed to ensure bolt fully engages the field type gate center stop when bolt is in 'down' position. Bottom of bolt shall be held flush or slightly above bottom of door when disengaged.

4. After building is in place with doors and cane bolts installed, set gate stop in wet concrete so that plate is flush with finished surface and channel is perpendicular to door's swinging path when fully open. Before the concrete sets verify that angle and position of gate stop will allow bolt to fully engage the gate stop at the center of the gate stop.

I. Tolerances:

1. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit adjacent work to damage hardware or hardware finish.

END OF SECTION

SECTION 08 11 14

BULLET-RESISTANT STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Works included:

1. All labor, material, equipment, and services necessary to furnish and install bullet-resistant primed-finish steel doors and doorframes to be located as shown on the construction drawings or as noted in the door and window schedules.

1.2 REFERENCES

A. Underwriters Laboratory

1. UL 752, Current Edition, Standard for Bullet-Resisting Equipment.

1.3 QUALITY ASSURANCE

A. Ballistic Performance: Certification shall be furnished indicating that all materials have been tested in accordance with the appropriate test procedures.

B. Obtain bullet-resistant components through one source from a single manufacturer.

1.4 SUBMITTALS

A. Shop Drawings shall be submitted for approval prior to the fabrication of materials. The drawings shall include plan views, elevations, sections, and details of the proposed installation including attachment methods.

B. Shop Drawings shall indicate dimensions, component profiles, and material finishes.

C. Manufacturer’s warranty and product data, glazing product information, and installation instructions shall be included with the submittal package.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Pack bullet-resistant doors/frames in wood crates for shipment. Glazing should be crated separately, unless doors are factory glazed.

B. All items shall be delivered, stored, and handled in a manner that will not damage or deform.

C. Abraded, scarred, or rusty areas shall be cleaned, repaired, or replaced immediately upon detection. Damaged items that cannot be restored to like-new condition shall be replaced.

D. Store crated components in a dry location on platforms or pallets that are adequately ventilated, free of dust, water, and other contaminants, and stored in a manner that permits easy access for inspection and handling.

1.6 JOB CONDITIONS

A. Field Measurements: Contractor shall verify frame openings by field measurement prior to fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: If field measurements cannot be made without causing a delay, establish opening dimensions and proceed with fabrication of bullet-resistant frames without field measurements. Coordinate construction to ensure that the actual opening dimensions correspond to the established dimensions.

PART 2 PRODUCTS

2.1 STEEL DOORS AND FRAMES

A. Manufacturers:

1. North American Bullet Proof, Shotgard Series.
2. U.S. Bullet Proofing.
3. Substitutions: Permitted with prior written approval by Engineer.

2.2 MATERIALS

A. Bullet-Resistant Primed-Finish Steel Doors and Doorframes:

1. Bullet-Resistant SDR Primed-Finish Steel Door and Primed-Finish Steel Doorframe
2. Frames, doors, and glazing shall be supplied to provide a complete assembly.
3. Ballistic Resistance Performance Level: U.L. 752, Level 4.
4. SDR integral door/frame system to provide ballistic overlap protection.
5. SDR Primed-Finish Steel Door to be constructed of 10-gauge steel skins over tube-steel skeleton with mitered, continuously welded corners.
6. SDR Primed-Finish Steel Doorframe to be constructed of 12-gauge steel with mitered, continuously welded corners.
7. Frame Profile: 2” x 5½” bolt-in frame, lined with steel as required for ballistic protection level.
8. View Window (when shown on drawings): 10” x 10” visual opening; performance level of the glazing to match the performance level of the door.
9. Door to be pre-hung with 1100-lb. rated continuous-gear hinge with security pins.
10. Door and frame to be prepped for mortise lock and standard strike.
11. Testing: Independently tested to U.L. 752 to level specified.

2.3 SDR COMPONENTS

A. Hinge: The SDR steel door shall be supplied pre-hung, with an 1100-lb. rated continuous-geared hinge with tamper-resistant dogging pins.

B. Silencers: Silencers shall be provided at the strike-jamb stop.

C. View Window Glazing: Glazing material shall be factory-fabricated units designed to be bullet-resistant to the specified test standard. Glazing material shall be glass-clad polycarbonate with a low-spall protected interior face. Low-spall interior face shall meet or exceed requirements for spall resistance defined in U.L. 752.

D. Setting Blocks: provide 1/4" x 1" x 4" rubber setting blocks for installation at the sill.

E. Anchor-hole Plugs: Provide decorative plugs to cover anchor-access holes.

F. Anchors and Sealants to be provided by installer.

G. Floor door closers (where shown on drawings):

1. Manufacturers:
    a. ASSA ABLOY Rixson Model L27
    b. Substitutions: Approved Equal
2. Heavy duty, floor-mounted door closer
3. Rated to wind speed of 90 mph
4. Rated to weight of bullet-resistant door
5. Built-in positive dead stop to prevent door from opening beyond maximum opening degree of 105°.
6. Shall feature separate and independent valves for closing speed, latch speed and backcheck.

H. Top Jamb door closers (where shown on drawings):

1. Manufacturers:
    a. Norton Model 7500 Industrial Series
    b. Substitutions: Approved Equal
2. Rigid, Heavy duty, top jamb-mounted door closer
3. Non-adjustable arm
4. Opening degree of 180°.

I. Heavy duty cane bolt and gate stop assembly to hold open doors:

1. 5/8" diameter, 36" long, black steel cane bolt.
    a. Bolt must be able to be kept in the 'up/unengaged' position, such that operator need not hold the bolt up as door is opened or closed.
2. Minimum 6" throw, or more to allow full engagement with the gate stop set into concrete porch or driveway.
3. Gate stop shall be a field type gate center stop (set in concrete porch or driveway), part number HS 015 913-34 (custom) as by Hardware Specialties of Albuquerque, OAE
    a. 3"x5" rectangular cold-plate steel formed with 7/8" wide, 3" long, 1" deep at center concave channel.
    b. 5/8" diameter, 5" long cold rolled steel bar affixed to bottom center of plate.

2.4 FABRICATION

A. General: Fabricate bullet-resistant components to comply with indicated standards. Include a complete system for assembly and installation of bullet-resistant components.
   1. Provide doors that are capable of being reglazed from the secure side without dismantling the threat side of the frame.
   2. Prepare doors for glazing in the field, unless preglazing at the factory is indicated.
   3. Steel shall be free of scale, pitting, coil breaks, and finish work shall be neat and free of defects.

B. Framing: Miter corners the full depth of the frame. Continuously weld and dress smooth. No body fillers to be used.
   1. Install armor inside the frame in the thickness necessary for the ballistic resistance level indicated.
   2. Prep frame for standard 4⅞" ANSI strike at 40 inches above finished floor.
   3. Provide spreader at bottom of doorframe for protection during shipping, and for easier, cleaner installation.

C. View Window Stops: Provide a one-piece removable glazing stop, two-inch depth, made from 12-gauge steel, on the secure side of the frame attached with machine screws.
   1. Corners are to be mitered, welded, and dressed smooth.
   2. Stops shall be installed in a location appropriate for the glazing thickness.
   3. Finish glazing stops to match door finish.
   4. The threat-side glazing stop shall be welded-in-place 3/8" ballistic steel.

D. SDR: Fabricate steel doors with 10 gauge steel door skins.
   1. Proprietary adhesive to be used to bond door skins to door structure.
   2. Prep door for lockset to line-up with strike.
   3. Hinge reinforcement: Provide 3/16" steel continuous hinge reinforcement, welded to door edge.

E. Hardware: Templates are to be provided to the door manufacturer by the hardware contractor. The installing contractor shall perform drilling and tapping for surface mounted hardware at the jobsite.

F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

G. Any openings in glazing for are to be factory-cut.

H. No field alterations to the construction of the units fabricated under the specified standards shall be allowed unless approved by the manufacturer.

2.5 FINISHES

A. Provide shop-applied primer after fabrication:

1. Prior to shop painting, surfaces shall be cleaned with solvents to remove any grease or oil, and with power wire-brushing or sandblasting to remove loose rust, loose mill scale and other foreign substances.
2. Primer: Rust inhibitive paint suitable as a base for finish coating.

B. Door manufacturer shall provide finish powder coating of the surfaces of the door prior to shipment, per coating manufacturer's instructions, color to be selected by Owner.

C. Steel Sheet: Shop finished galvanized to ASTM A653/A653M A40.

D. Finishes: ANSI A156.18; furnish following finishes unless otherwise noted.

1. Hinges:
   a. BHMA 630 and 626, satin finish.
2. Typical Exterior Exposed and High Use Interior Door Hardware:
   a. BHMA 630, satin finished stainless steel.
3. Typical Interior Door Hardware:
   a. BHMA 626, satin chromium plated brass or bronze.
4. Thresholds: Finish appearance to match door hardware on exterior face of door.
   a. BHMA 628, satin aluminum, clear anodized.
5. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

2.6 LABELING

A. Bullet-resistant components shall be plainly and permanently labeled. The label shall be compatible with finishes. The label shall be visible only on the secure side, after installation, and shall include:

1. Manufacturer's name or identifying symbol.
2. Model Number.
3. Date of manufacture by month and year. This may be done through use of lot number or other traceable code.
4. Correct mounting position including threat side and secure side.
5. Code indicating bullet-resistant rating and test standard used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to commencing installation, examine all areas to receive the bullet-resistant doors and frames to ensure that they are ready for installation. Components shall be checked and corrected for racking, twisting, and other malformation prior to installation. All surfaces and connections shall be examined for damage prior to installation.

B. Verify that the doors and frames comply with indicated requirements for type, size, and location.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. The Contractor shall field verify dimensions of the finished openings. SDR bolt-in frames must be installed in a plumb, level, and square finished opening. The finished opening must be 1/4" larger in width and in height than the doorframe.

3.3 INSTALLATION

A. Install: Place the frame in the opening, centered on wall. Mark the anchor holes. Remove the frame and drill the anchor holes. Install the frame and shim for plumb/level. Secure with anchors. Note: all anchors provided by installer.

B. Test: Test the door for proper fit and operation. If required, remove the unit, adjust the shims, and reinstall. Install the anchor-hole plugs.

C. Finish: Seal all joints in and around the frame. Sand and finish the frame. Wait until all sealants and paint are cured before operating.

D. Glazing: Identify the secure and threat sides of the glass. Remove any protective cover from the glazing. Apply butyl tape to the view widow stops. Place the rubber setting blocks in the opening. Install glazing, making sure it fits properly. Install the removable stop using the screws provided with the window. Apply sealant over butyl tape.

E. Cane bolt and gate stop assembly to hold open doors:

1. Cane bolts must be factory welded to doors for pre-fabricated buildings.

2. If cane bolt assembly welded to door in field, touch-up paint and door finish as needed after welding.

3. Weld cane bolt assembly to steel door so as to allow 6" of throw, or more if needed to ensure bolt fully engages the field type gate center stop when bolt is in 'down' position. Bottom of bolt shall be held flush or slightly above bottom of door when disengaged.

4. After building is in place with doors and cane bolts installed, set gate stop in wet concrete so that plate is flush with finished surface and channel is perpendicular to door's swinging path when fully open. Before the concrete sets verify that angle and position of gate stop will allow bolt to fully engage the gate stop at the center of the gate stop.

3.4 ADJUST AND CLEAN

A. Use care and follow instructions for cleaning the glazing.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Overhead coiling insulated doors.

B. Related Sections:

1. Section 06 10 00 - Rough Carpentry.
2. Section 08 71 00 - Door Hardware.

1.2 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM A123 Zinc [hot-dipped galvanized] coatings on iron and steel products.
2. ASTM A229 Steel wire, oil-tempered for mechanical springs.
3. ASTM A-653-94 Steel sheet, zinc-coated [galvanized] by the hot-dipped process, commercial quality.
4. ASTM E330 Structural performance of exterior windows, curtain walls, and doors by uniform static air pressure difference.
5. ASTM E413-87 Sound transmission class acoustical performance value = 22.
6. ANSI/DASMA 203 American National Standards Institute Specifications for non-rated fire rolling doors published by Door & Access Systems Manufacturers Association International.

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. Overhead coiling insulated doors:

1. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf without damage to door or assembly components while closed and while in operation.
2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.

B. Single-Source Responsibility: Provide doors, tracks, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 00 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Details of construction and fabrication.
4. Installation instructions.

C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color charts representing manufacturer's full range of available colors and patterns. Color to be determined by owner.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.

B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.

C. Store materials in a dry, warm, ventilated weather tight location.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 COORDINATION

A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. Overhead Door Corp.

a. Stormtite 625 Series

2. Wayne Dalton Corp.

a. 800C Series

3. Requests for substitutions will be considered in accordance with provisions of Section 01 00 00.

2.2 INSULATED OVERHEAD COILING SERVICE DOORS

A. Overhead Coiling Insulated Service Doors:

1. Curtain: Interlocking roll-formed slats

a. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.

b. Flat profile type F-265I or #14 flat slats.

c. Front slat fabricated of:

1) Minimum 20 gauge galvanized steel.

d. Back slat fabricated of:

1) Minimum 20 gauge galvanized steel.

e. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation, with minimum R-value of 7.7 (U = 0.15).

2. Finish:

a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A653 and receive rust-inhibitive, roll coating process, including minimum thickness of 0.2 mils thick baked-on prime paint, and minimum thickness of 0.6 mils thick baked-on polyester top coat.

1) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.

2) Top Coat Color:

a) Powder coating finish in color as selected by Owner from manufacturer’s standard colors.

3. Weatherseals:

a. Vinyl bottom seal, exterior guide and internal hood seals.

4. Bottom Bar:
    a. Two prime painted steel angles minimum thickness 0.121 inch bolted back to back to reinforce curtain in the guides.
5. Guides:
    a. Three prime painted structural steel angles with minimum thickness of 3/16 inch.
    b. Guides weatherstripped with a vinyl weather seal at each jamb, on the exterior curtain side.
6. Brackets:
    a. Hot rolled prime painted steel with minimum thickness of 3/16 inch to support counterbalance, curtain and hood.
7. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to maximum of 0.033 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
8. Hood: Provide with internal hood baffle weatherseal.
    a. Minimum 24 gauge galvanized steel with intermediate supports as required.
9. Manual Operation:
    a. Chain hoist.
10. Locking:
    a. Chain keeper locks for chain hoist operation.
    b. Door shall have interior slide bolt lock suitable for padlocks (padlocks to be provided by others).
11. Wall Mounting Condition:
    a. Face-of-wall mounting to masonry

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify opening sizes, tolerances and conditions are acceptable.

B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.

C. If substrate preparation is the responsibility of another installer, notify Owner of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, utilizing authorized manufacturer's representative if required by manufacturer.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Install perimeter trim and closures.

F. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

3.4 ADJUSTING

A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes hardware for steel doors.

1. Provide door gaskets, including weather-stripping and seals, and locksets.

B. Related Sections:

1. Section 08 11 13 Steel Doors and Frames

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI A156.2 - Bored and Preassembled Locks and Latches.
2. ANSI A156.3 - Exit Devices.
3. ANSI A156.4 - Door Controls - Closures.
4. ANSI A156.5 - Auxiliary Locks and Associated Products.
5. ANSI A156.6 - Architectural Door Trim.
6. ANSI A156.7 - Template Hinge Dimensions.
7. ANSI A156.8 - Door Controls - Overhead Holders.
8. ANSI A156.12 - Interconnected Locks and Latches.
9. ANSI A156.13 - Mortise Locks and Latches.
10. ANSI A156.14 - Sliding and Folding Door Hardware.
11. ANSI A156.15 - Closer Holder Release Devices.
12. ANSI A156.16 - Auxiliary Hardware.
13. ANSI A156.18 - Materials and Finishes
14. ANSI A156.19 - Power Assist and Low Energy Power Operated Doors.
15. ANSI A156.23 - Electromagnetic Locks.
16. ANSI A156.24 - Delayed Egress Locks.
17. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.

B. Builders Hardware Manufacturers Association:

1. BHMA Directory of Certified Products.

C. National Fire Protection Association:

1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Underwriters Laboratories Inc.:

1. UL 10B - Fire Tests of Door Assemblies.
2. UL 305 - Panic Hardware.
3. UL - Building Materials Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by applicable authorities.

1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:

1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts.
2. Submit manufacturer's parts lists.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of installed cylinders and their master key code.

C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Product storage and handling requirements.

B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.7 COORDINATION

A. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.

1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

B. Sequence installation to accommodate required utility connections.

C. Coordinate Owner's keying requirements during course of Work.

1.8 WARRANTY

A. Furnish five year manufacturer warranty for locksets and door closers.

PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Manufacturers:

1. Bommer Industries, Inc.
2. Hager Companies.
3. Substitutions: Permitted.

B. Lockset Manufacturers:

1. Yale.
2. Substitutions: Permitted.

C. Closers Manufacturers:

1. Yale.
2. Norton.
3. Substitutions: Permitted.

2.2 COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
    a. Finish: Match hardware item being fastened.
4. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.
5. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Locksets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

1. Mortise Locksets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.
2. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.
3. Preassembled (Unit) Locksets: ANSI A156.12, Series 2000, Grade 1 unless otherwise indicated.
4. Interconnected Locksets: ANSI A156.12, Series 5000, Grade 1 unless otherwise indicated.

C. Latch Sets: Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.

1. Mortise Latch Sets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.
2. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.

D. Exit Devices: ANSI A156.3, Grade 1 concealed vertical rod type, with cross bar, unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, with dust-proof floor strikes.

1. Types: Suitable for doors requiring exit devices.
2. Coordinators: Furnish overhead concealed in frame type at pairs of doors.

E. Cylinders: ANSI A156.5, Grade 1, pin type removable cylinders.

1. Keying: Key to existing keying system.
2. Provide eight (8) original keys to Owner.

2.3 ACCESSORIES

A. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible.

1. Do not use through bolts on solid wood core doors.

2.4 FINISHING

A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule at end of section.

1. Typical Exterior Exposed and High Use Interior Door Hardware:
   a. BHMA 630, satin finished stainless steel.
2. Typical Interior Door Hardware:
   a. BHMA 626, satin chromium plated brass or bronze.
3. Other Items: Furnish manufacturer’s standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify doors and frames are ready to receive door hardware and dimensions are as instructed by manufacturer.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights from Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.

1. Locksets: 38 inch.
2. Push/Pulls: 42 inch.
3. Dead Locks: 48 inch.
4. Push Pad Type Exit Devices: 42 inch.
5. Cross Bar Type Exit Devices: 38 inch.

3.3 ADJUSTING

A. Adjust hardware for smooth operation.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit adjacent work to damage hardware or hardware finish.

3.5 SCHEDULES

A. Hardware Set 1: Fire rated.

1. Lock: Mortise lock, Classroom Function.
2. Closer: Surface mounted as specified.
3. Kickplate: 16 inch high, push side only.
4. Gaskets: Fire and smoke rated gaskets as specified.
5. Floor Stop: Dome type as specified.

END OF SECTION

SECTION 09 92 00

PROTECTIVE ANTI-GRAFFITI COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Materials and methods specifications for the following:

1. PRMAKOTE® (Anti-graffiti topcoat)
2. Sealer Prime SCS-002SP (Concrete primer)

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 04 20 00 - Unit Masonry

C. Section 08 11 13 - Steel Doors and Frames

D. Section 08 71 00 - Door Hardware

E. Section 33 16 19 - Welded Steel Water Storage Tank

1.3 SUBMITTAL REQUIREMENTS

A. General: Submit in accordance with Division 01 00 00.

B. Before any materials are delivered to the job site, the Contractor shall submit a complete list of all materials proposed to be furnished and applied under this section.

C. For each product, the Contractor shall provide the manufacturer's specific application instructions.

1.4 QUALITY ASSURANCE

A. Schedule of References: To the extent specified elsewhere in this Division, comply with the requirements of the following standards and associations.

1. Steel Structure Painting Council Specifications (SSPC).
2. National Association of Corrosion Engineers Standards (NACE).
3. Applicable Standards of American National Standards Institute, Inc. (ANSI).
4. Occupational Safety and Health Act regulations (OSHA).

B. Painter's Qualifications. The Contractor shall cause the work specified under this section to be performed by or under the supervision of a qualified painter. The Contractor shall be prepared to document the painter's experience, competence and ability to comply with the requirements of these specifications and to complete the work in a timely manner.

C. Standard Products. All materials, supplies and articles provided shall be the standards products of recognized, reputable manufacturers. All coatings shall be the products of a single manufacturer. The Contractor shall also minimize the number of suppliers.

D. The standard products of manufacturers other than those specified will be accepted when it is demonstrated to the satisfaction of the Engineer they are equal in composition, durability, usefulness and convenience for the purpose intended.

1.5 DELIVERY AND STORAGE

A. All materials shall be delivered to the job site in their original, unopened containers bearing the manufacturer's name, brand, batch number, date of manufacture, and any special directions. Only the approved material shall be stored at the job site and stored only in designated areas restricted to the storage of paint materials and related equipment. All coatings shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold. Flammable materials shall be stored to conform with state and local safety codes. Materials shall be protected from freezing. Materials exceeding storage life recommended by the manufacturer will be subject to rejection and, if so rejected, removed from the site.

1.6 MANUFACTURER REPRESENTATION

A. Require the manufacturer to make available a qualified technical representative to visit the job site for technical support if necessary, in order to resolve field problems attributable to or associated with the manufacturer's products furnished under this contract.

1.7 PROTECTION OF SURFACES NOT TO BE COATED

A. Protect surfaces and equipment which are not to receive coatings during surface preparation, cleaning and painting operations.

B. Conduct spraying of coatings under controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from spray operations.

PART 2 PRODUCTS

2.1 ANTI-GRAFFITI COATING AND PRIMER

A. Products:

1. Anti-graffiti coating: PRMAKOTE®

a. PERFORMANCE CRITERIA:

1) ASTM D6578 - Graffiti Resistance Test (Level 8.0)

b. TECHNICAL DATA:

1) Non-Sacrificial Graffiti Resistant Coating

2) One component, water-based, copolymer plastic coating

3) STORAGE & HANDLING: Store between 34°F (1°C) to 120°F (49°C) in a cool, dry, well-ventilated area, out of direct sunlight and moisture, for up to 60 months.

4) Keep unused material tightly closed at all times. KEEP FROM FREEZING

2. Primer: Sealer Prime SCS-002SP

a. PERFORMANCE CRITERIA:

1) Water Absorption

a) ASTM C 67 and 642-90: 4% max. after 24hr./75F

2) Water Vapor Transmission Rate

a) ASTM E 96-56:11.82 Perms

3) Water Vapor Transmission

a) ASTM D1653-93: 4.97 grains/hr/ft2

4) Household Chemicals

a) ASTM D1308-97: Pass

b. TECHNICAL DATA:

1) STORAGE & HANDLING: Store between 40°F (4°C) to 90°F (32°C) in a cool, dry, well-ventilated area, out of direct sunlight and moisture.

2) Keep unused material tightly closed at all times. KEEP FROM FREEZING

B. Manufacturer:

1. SEI Industrial Chemicals

2. Substitutions: None

PART 3 EXECUTION

3.1 SYSTEM 1 - COATING OF EXTERIOR METAL

A. Area of Application: All exterior metal doors/metal components on the sides of the pump station buildings (areas susceptible to graffiti).

B. Protective coating required:

1. Two coats of PRMAKOTE®

3.2 SYSTEM 2 - COATING OF SPLIT FACE CONCRETE BLOCK

A. Area of Application: All exterior exposed split face concrete block surfaces.

B. Protective coatings required:

1. Two coats of Sealer Prime SCS-002SP

2. Two coats of PRMAKOTE®

3.3 SURFACE PREPARATION

A. ALL SURFACES:

1. The surface is to be dry, clean and free of any foreign matter including corrosion, hydrocarbons, moisture, ice, efflorescence, silicones, fluoro-products, etc.
2. Always test the coatings adhesion and performance before a full application.
3. To help achieve greater coverage rates when applying to a porous substrate, first apply SEI Industrial's SCS-002SP in accordance with manufacturers' suggested application guidelines.
4. Allow porous substrates to dry for a minimum of 72 hours after pressure washing.
5. After rain, allow 48 hours to dry.
6. New concrete should be allowed to cure for 28 days.
7. All caulking and finishing should be done before PRMAKOTE® application.
8. Prior to application, protect all glass, vehicles and surrounding surfaces from overspray.
9. Always apply to a test area before proceeding with entire application.

B. SURFACE TEMPERATURE:

1. 34°F (1°C) to 140°F (60°C).
2. Surface should be dry (at least 5°F (3°C) above the dew point) with no damp or frozen moisture within the substrate.
3. This product will cure slower in lower temperatures.

3.4 COATING APPLICATION

A. TYPICAL COVERAGE RATES:

1. Anti-graffiti coating: PRMAKOTE®

Surface	Square Feet per Gallon
Concrete	300 - 450
Brick	300 - 320
C.M.U.	300 - 320
Split-Faced Block	300 - 320
Stucco	300 - 320
Metal(s)	500 - 600

2. Primer: Sealer Prime SCS-002SP

Surface	Square Feet per Gallon	Surface	Square Feet per Gallon
CMU - Fluted	35 - 65	Rough Wood	50 - 80
CMU - Split face	30 - 60	Smooth Wood	80 - 125
CMU - Smooth	80 - 100	Wood Shingles	70 - 90
Rough/cracked	30 - 60	Smooth Stone	100 - 125
Exterior Brick	60 - 80	Metal(s)	150 - 300
Concrete	80 - 100	Smooth Painted	150 - 170
Concrete Block	80 - 100	Rough Painted	100 - 150
Stucco	60 - 80		

B. CURING TIMES:

1. Anti-graffiti coating: PRMAKOTE®

a. CURING TIMES @ 75°F (24°C):

1) To Touch: Approximately 3 hours

2) To Cure: Approximately 24 hours

2. Primer: Sealer Prime SCS-002SP

1) CURING TIME: 75F (24C):

a) Dry Time: 45min. - 1 hour

b) To Recoat: 30 minutes

C. APPLICATION LIMITATIONS:

1. LIMITATIONS:

a. Product application must not be initiated during inclement weather or when precipitation appears to be imminent.

b. Product must not be applied to wet, frozen or dirty surfaces.

c. Product must not be applied when conditions are windy as over spray is a hazard and environmental contaminants dispersed from windy conditions can land in the coating during curing.

d. Always apply test area before proceeding with entire application.

D. PRMAKOTE®

1. GENERAL INFORMATION:

a. For optimum performance, allow individual coats to be fully cured before applying the next application.

2. MIXING:

   a. Mix well by shaking the product container. After mixing, ensure the product is clear in appearance, consistent in thickness and that there is no settled/cured material within the container. Any cured or foreign material must be removed, by pouring the product through a paint strainer, prior to application.

3. POT LIFE & THINNING:

   a. Do not thin. Pot life can vary dependent upon temperature and humidity. Application time should not exceed 8 hours after the product has been opened.

4. EQUIPMENT:

   a. Apply via airless sprayer, roller or brush. Use a flood coat and apply liberally.

5. BRUSH:

   a. Use of poly-foam is generally preferred, and is also used to brush out build-ups and drips.

6. ROLLER:

   a. A roller suitable for use with water-based paints should be used. Apply to porous substrates from the bottom up. Rollers should only be used on smooth surfaces or to remove runs from rough textured surfaces. To help ensure the product penetrates porous substrates, saturate the roller and apply slowly, allowing excess product to build on top of the roller.

7. SPRAY:

   a. Providing a minimum of 1500 psi through a tip appropriate for the surface being sprayed. To apply by means of an airless sprayer, hold the spray tip about 8-12 inches from the surface and move it horizontally, maintaining the distance from the surface to the limit of arm movement. The spray gun should be held at right angles to the surface. For optimum performance allow the first coat to fully dry and cure before applying the second coat.

8. CLEANUP:

   a. Flush and clean all equipment immediately after use. Product is water-based, clean up with soap and water.

9. Upon completion of all coating activities, the Contractor shall remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other coating-related damage.

E. SEALER PRIME SCS-002SP

1. GENERAL INFORMATION:

   a. SCS-002SP is designed for above grade use only.

   b. Take special care to saturate joints, cracks and large pores.

c. When first applied, the emulsified resins appear milky white. The micro emulsions will then coalesce drying clear and colorless. The milky appearance should last no longer than approximately 30 minutes.

d. When applying the SCS-002SP for use a prime coat, always test an inconspicuous area to determine how fast the sealer is absorbed into the substrate. After the test application, let dry for 30-60 minutes and then feel the dry film on the substrate. Press your thumb firmly against the dry film and pull back slowly; one should feel a sticky sensation. If this is not experienced the SCS-002SP has not provided a sufficient film and an additional coat should be applied.

2. WATER BEAD TEST:

a. Spray water onto the dry film with a trigger spray bottle. Water will either bead on the surface or darken/wet out the underlying substrate, which indicates absorption and an additional coat should be applied. If the water beads and does not absorb or darken the substrate the film is providing some moisture protection. For further and more in depth technical testing use a Rilem Tube to test the film's moisture resistance. If the SCS-002SP has passed the Water Bead and/or Rilem Tube test(s), the coating is intact and ready for an application of a topcoat.

3. MIXING:

a. Mix well by shaking the product. Ensure there is no settled/cured material on the film or within the container. Cured or foreign matter must be removed prior to application.

4. POT LIFE & THINNING:

a. Do not thin. Pot life can vary depending temperature and humidity but typically open product can be used for up to 1 month if sealed and stored according to specification.

5. APPLICATION EQUIPMENT:

a. Mix or shake well before application. Ensure product is consistent in thickness after stirring. Apply via HVLP, airless sprayer, pump sprayer, roller or brush. Use a flood coat and apply liberally.

b. Roller:

1) Use ½" synthetic nap roller. To a porous substrate apply from the bottom up. Excess buildup of product can accumulate on roller. Allow the product to saturate and flood the top of the roller and apply slowly as this will allow product to penetrate the substrate.

c. Spray:

1) Apply with low pressure using a tip size ranging from .011-.021". Back roll if needed. Apply from top to bottom chasing runs. Product can be applied wet on wet or wet on dry. For optimum performance allow the first coat to fully dry and cure before applying the second coat.

2) Hold spray tips 4-12 inches from the surface depending on application and substrate, start at the top and work down the substrate chasing the run with an overlapping horizontal spray pattern.

6. CLEAN UP:

a. Flush and clean all equipment immediately after using warm soapy water.

7. STORAGE & HANDLING:

a. Must be stored and handled in compliance with all current local regulations for flammable liquids. Store in cool, dry, well-ventilated areas, out of direct sunlight and moisture.

8. GENERAL APPLICATION NOTES:

a. Allow a minimum of 24 hours to cure before proceeding with water-bead testing as described below.

b. Substrate areas that have received concrete patching material may have increased absorbency and may require more SP to be applied while carrying out the initial product application.

9. Upon completion of all coating activities, the Contractor shall remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other coating-related damage.

3.5 TESTING

A. PRMAKOTE®

1. A minimum of 24 hours curing time is ideal before testing graffiti removal performance.

2. When testing the cured film for graffiti removal performance, apply spray paint to a small inconspicuous area and allow the spray paint to fully cure before proceeding with its removal.

3. A dry cloth is an acceptable means of testing for removing graffiti from the cured film; however, dampening the cloth with water will allow it to slide across the protective coating much easier. If the coating film is of proper thickness, spray paint should be easily removed.

3.6 REMOVAL OF GRAFFITI

A. Remove graffiti as soon as possible after surface has been vandalized.

B. If the coating has been damaged or removed, make sure the surface is clean and dry and reapply as described in the Application section.

C. Always test chemical cleaners before moving into a full application.

D. Options for removing graffiti:

1. Dry rag or cloth

a. To remove markers always use a dry cloth first.

2. Pressure washer.
3. Water and detergent with a rag or cloth.

E. Flush the coating with water after chemical cleaning to ensure the integrity of the coating.

F. For removing graffiti over large areas, or for removing graffiti from rough surfaces:

1. Use a cold-water pressure washer with a 25 - 40° nozzle.
2. Start the flow of water away from the removal area and then reposition the nozzle at a slight angular effective distance from the PRMAKOTE® coated surface.
3. Move the pressure washing wand in a continuous back and forth motion, so as not to focus the nozzle in one location during the graffiti removal.
    a. Focusing the nozzle in one location may damage the PRMAKOTE® film.

END OF SECTION

SECTION 09 97 14

WATER STORAGE TANK PAINTING

PART 1 GENERAL

1.1 SCOPE

A. The work of this section includes the coating of all interior surfaces, and the painting of all exterior surfaces on new tanks.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Related Sections:

1. Section 33 13 13 Water Storage Tank Disinfection.

2. Section 33 16 19 Welded Steel Water Storage Tank.

1.3 REFERENCE SPECIFICATIONS AND STANDARDS

A. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of interior and exterior surfaces and inspection shall conform to the applicable requirements of the Society for Protective Coatings, NACE International, ASTM (American Society for Testing and Materials), AWWA and the manufacturer's printed instructions.

B. Navajo Tribal Utility Authority
1. Technical Specification, Water Storage Tank Renovation, Revision 1.5 or latest.

C. American Society for Testing and Materials (ASTM) International:

1. ASTM D4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

2. ASTM E337 Standard Practice Test Method for Measuring Humidity with a Psychrometer

3. ASTM D2200 Standard Methods of Evaluating Degree of Rusting on Painted Surfaces

4. ASTM D5402 Solvent Resistance Rub Test

D. American National Standards Institute (ANSI)

1. ANSI/ASC 29.4 Exhaust Systems
Abrasive Blasting Operations – Ventilation and Safe Practice

E. American Water Works Association (AWWA)

1. AWWA D102 Coating Steel Water Storage Tanks

F. Consumer Product Safety Act, Part 1303

G. Environmental Protection Agency

1. EPA 524.2 Revision 4 Purgeable VOCs by GC/MS

H. National Association of Corrosion Engineers (NACE) International

1.	NACE Publication TPC2	Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
2.	NACE Standard SP0178	Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service
3.	NACE Standard SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates (Holiday) Testing of Protective Coatings
4.	NACE Standard RP0287	Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
5.	NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete

I. Occupational Safety & Health Administration (OSHA)

1. 1915.35Standards – 29 CFR – Painting

J. Society for Protective Coatings (SSPC)

1.	SSPC-SP2	Hand Tool Cleaning
2.	SSPC-SP3	Power Tool Cleaning
3.	SSPC-PA-1	Shop, Field and Maintenance Painting
4.	SSPC-PA-2	Measurement of Dry Film Thickness with Magnetic Gages
5.	SSPC-PA-3	Guide to Safety in Paint Application
6.	SSPC-Guide 12	Guide for Illumination of Industrial Painting Project
7.	SSPC-VIS 1-89	Pictorial Surface Preparation Standards for Painting Steel Surfaces
8.	SSPC Paint Spec 36	Two Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based

K. SSPC/NACE Joint Standards

1.	SSPC-SP5/NACE 1	White Metal Blast Cleaning
2.	SSPC-SP6/NACE 3	Commercial Blast Cleaning
3.	SSPC-SP7/NACE 4	Brush-Off Blast Cleaning
4.	SSPC-SP10/NACE 2	Near-White Metal Blast Cleaning

L. NSF International / American National Standards Institute (ANSI)

1. NSF/ANSI 61 - Drinking Water System Components - Health Effects

2. NSF 600 Health Effects – Solvent Criteria

M. The Engineer's decision shall be final as to the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

1.4 CONTRACTOR QUALIFICATIONS

A. Contractor shall have five years practical experience and successful history in the application of specified product to surfaces of steel water tanks. Upon request, he shall substantiate this requirement by furnishing a list of references and job completions.

B. The personnel performing the work shall be knowledgeable and have the required experience and skill to adequately perform the work for this project, in accordance with SSPC-PA1, “Shop, Field and Maintenance Painting”.

1.5 QUALITY ASSURANCE

A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the Engineer.

B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces: SSPC-VIS 1-89”, ASTM D2200-95, "Standard Methods of Evaluating Degree of Rusting on Painted Surfaces”, ASTM D 4417-91, Method A and/or Method C or NACE Standard RP0287-87. In all cases the written standard shall take precedence over the visual standard. In addition, NACE Standard RP0178-91, along with the Visual Comparator, shall be used to verify the surface preparation of welds.

C. Application: No coating or paint shall be applied when: 1) the surrounding air temperature or the temperature of the surface to be coated or painted is below the minimum surface temperature for the products specified herein, 2) rain, snow, fog or mist is present, 3) the surface temperature is less than 5 degrees F above the dew point, 4) the air and steel temperature is below 50°F or above 120°F, the air temperature is expected to drop below the minimum temperature for the products specified within six hours after application of coating. Dewpoint shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. If any of the above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

D. Thickness and Holiday Checking: Thickness of coatings and paint shall be checked with a non-destructive, magnetic-type thickness gauge, as per SSPC-PA 2 “Measurement of Dry Film Thickness with Magnetic Gages”. References in SSPC-PA 2 which allow 80% of the minimum thickness specified are not acceptable. Use an instrument such as a Tooke Gauge if a destructive test is deemed necessary by the Engineer.

E. The integrity of interior coated surfaces shall be checked with a low voltage holiday detector in accordance with NACE Standard RP0188. Non-destructive holiday detector shall not exceed 67.5 volts, nor shall destructive holiday detector exceed the voltage recommended by the manufacturer of the coating system. A solution of 1 ounce non-sudsing type wetting agent, such as Kodak Photo-Flo, or approved equal, and 1 gallon of tap water shall be used to perform the holiday testing. All pinholes and/or holidays shall be marked and repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating. Holiday testing frequency shall be 100%.

F. Inspection Devices: Contractor shall furnish, until final acceptance of coating and painting is accepted, inspection devices in good working condition for detection of holidays and measurement of dry film thickness of coating and paint. The Contractor shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates and/or plastic shims, depending upon the thickness gauge used, to test the accuracy of dry film thickness gauges and certified instrumentation to test the accuracy of holiday detectors. Dry film gauges and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Engineer.

G. Independent NACE Inspection: Inspection for this project shall include inspections conducted by an independent National Association of Corrosion Engineers (NACE) certified inspector with a minimum of five years documented experience on similar projects.

1. Contractor shall identify and provide an independent NACE-certified inspector, who possesses appropriate professional liability insurance and is completely independent of the tank and coating manufacturers, to inspect the work at Contractor’s expense. Contractor shall submit name and qualifications of NACE certified inspector to Engineer and Owner for approval prior to commencing work.
2. The NACE certified inspector will identify the testing and test sequencing requirements prior to commencement of the work. The Contractor shall coordinate activities with the Engineer and NACE certified inspector related to the inspection of surface preparations and coatings as well as a holiday inspection, as required by the NACE certified inspector.
3. At a minimum, the inspector shall inspect the surface prior to abrasive blasting, after abrasive blasting but prior to application of coating materials, and between subsequent coats of material. Final inspection shall take place after all coatings are applied, but prior to placing the tank in service. Contractor will ensure that sufficient rigging is in place so that the inspector shall be able to conduct the required inspections.

H. MEK Double Rub Test: After the tank has reached “full cure” in accordance with the recommendations and written published data sheets of the coating manufacturer, the inspector shall perform MEK double rub tests in accordance with ASTM D5402 to verify curing of the interior coating system.

1.6 WARRANTY INSPECTION

A. Warranty inspection shall be conducted during the eleventh month following acceptance of all coating and painting work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Engineer and/or Owner.
   1. The NACE certified inspector will attend the Warranty Inspection at the Contractor's expense, along with the Contractor, Engineer and Owner Representative.

B. Inspection Procedure:
   1. Contractor shall coordinate with Owner, Engineer and NACE Inspector prior to inspection.
   2. Owner shall drain the tank prior to inspection, at Owner's expense.
   3. Contractor shall provide all equipment and support required to give the NACE Inspector safe access to all interior and exterior surfaces. Such equipment and support may include scaffolding, ventilation, or other safety equipment, as needed.
   4. NACE Inspector shall inspect the interior and exterior of the tank for visual defects, holidays, and other criteria deemed necessary by the Inspector.
   5. After inspection, Contractor shall immediately repair all defects identified by the Inspector, in accordance with coating manufacturer's recommendations.
      a. In the event that the Contractor is not able to repair all defects immediately and the tank must be refilled prior to repair, Contractor shall be responsible for any subsequent draining and refilling of the tank at Contractor's expense.
   6. After all repairs are completed and accepted by the Owner, Contractor shall disinfect the tank at Contractor's expense, in accordance with Section 33 13 13 – Water Storage Tank Disinfection.
   7. Water to refill the tank one time shall be provided at no expense to the Contractor. The Contractor is advised that NTUA may charge for additional water.

C. Repair of Coating Failures:
   1. Documented coating failures shall be repaired by the Contractor in accordance with the coating manufacturer's recommendations.
   2. If the repairs require that the tank be drained, the Contractor shall coordinate the work with the water system operator and provide all equipment, labor and materials, including temporary storage if necessary, to complete the repairs.
   3. Upon completion of the repair work, the tank will be disinfected in accordance with AWWA requirements and placed back into service.

1.7 SAFETY AND HEALTH REQUIREMENTS

A. The requirements listed herein are not exhaustive, and nothing in these specifications shall relieve Contractor from full responsibility over all aspects of safety on the project.

B. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate technical

bulletins and manuals, the Contractor shall provide and require use of personal protective lifesaving equipment for persons working on or about the project site. The Contractor's work forces should comply with the provisions outlined in SSPC-PA-3 "A Guide to Safety in Paint Application".

C. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear eye and face protection devices and air purifying half-mask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.

D. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to a degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

E. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protection devices.

F. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the inspector.

G. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be moved by the Contractor to locations requested by the Engineer.

1.8 PRODUCT DELIVERY, STORAGE & HANDLING

A. All materials shall be brought to the jobsite in original sealed containers. They shall not be used until the Engineer, or Resident Project Representative, has inspected the contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.

B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings and paints must be stored to conform to City, County, State and Federal safety codes for flammable coating or paint materials. At all times coatings and paints shall be protected from freezing.

PART 2 MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

A. Coating manufacturer in accordance with NTUA Technical Specification “Water Storage Tank Renovation”, version 1.5, or latest. Substitutions are not allowed.

B. Manufacturer's color charts shall be submitted to the Engineer at least 30 days prior to coating and/or paint application. General Contractor and Painting Contractor shall

coordinate work so as to allow sufficient time (normally seven to ten days) for paint to be delivered to the job site.

2.2 GENERAL REQUIREMENTS

A. All materials shall be lead-free as defined by the Consumer Product Safety Act, Part 1303.

B. All materials for the interior of the tank shall meet the requirements of ANSI/NSF Standard 61 for potable water contact to include VOC compliance with NSF 600.

C. All high gloss clear coat products shall incorporate the use of a fugitive dye to aid in the proper application and coverage of such coats.

D. All catalyzed polyurethane products shall meet the minimum requirements of SSPC Paint Specification Number 36, Level 3 Performance Level.

E. No products containing MOCHA shall be allowed.

F. Inorganic zinc-rich primers shall not be utilized as a permanent part of the interior coating system on this project. Inorganic zinc-rich pre-primers, if used, shall be completely blasted and removed prior to installing the coating system on the interior water compartment. All surface preparation shall be to the degree specified herein.

2.3 MATERIAL PREPARATION

A. Mix and thin materials according to manufacturer's latest printed instructions.

B. Do not use materials beyond manufacturer's recommended shelf life.

C. Do not use mixed materials beyond manufacturer's recommended pot life.

2.4 TANK INTERIOR COATING SYSTEM

A. Polyamidoamine Epoxy System:

1. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour.

2. All welds shall be ground to a smooth contour as per NACE Standard RP0178 and herein.

3. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning. Anchor profile shall be 2.0 to 4.5 mils as per ASTM D4417, Method C or NACE Standard RP0287. Anchor profile shall be primarily angular and irregular, as produced by grit.

4. A brush applied stripe coat shall be applied to all weld seams and irregular edges, corners and crevices prior to spray application.

5. Coating System:
   a. Interior primer and finish coat material and thickness Coating system to comply with NTUA Technical Specification “Water Storage Tank Renovation”, version 1.5, or latest.
   b. Primer: Tnemec Series 21-1255 Beige Epoxoline

c. Finish Coat: Tnemec Series 21-WH16 Off White Epoxoline

6. Thin only with approved thinners
7. The cumulative Dry Film Thickness (DFT) and Wet Film Thickness (WFT) shall be in accordance with NTUA Technical Specification "Water Storage Tank Renovation", version 1.5, or latest.

2.5 TANK EXTERIOR COATING SYSTEM

A. Hydrophobic Acrylic Polymer System:

1. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard RP0178 and herein.
2. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning. Anchor profile shall be 1.5 to 2.5 mils as per ASTM D4417, Method C or NACE Standard RP0287.
3. A brush applied stripe coat shall be applied to all weld seams and irregular edges, corners and crevices prior to spray application.
4. Coating System:
   a. Interior primer and finish coat material and thickness Coating system to comply with NTUA Technical Specification "Water Storage Tank Renovation", version 1.5, or latest.
   b. Primer: Tnemec Series 21-1255 Beige Epoxoline
   c. Finish Coat: Tnemec Series 1029 Enduratone Desert Tan
5. Thin only with approved thinners
6. The cumulative Dry Film Thickness (DFT) and Wet Film Thickness (WFT) shall be in accordance with NTUA Technical Specification "Water Storage Tank Renovation", version 1.5, or latest.

2.6 Exterior Tank Floor (Underside):

A. Coat underside of floor with 20 mil DFT of coal tar epoxy, Tnemec Series 46H-413.

B. It is not necessary to re-coat the underside of the floor after welding.

2.7 Interior Roof Laps:

A. Interior: Match tank interior coating schedule

B. Seal welds for interior lap joints are required, Sikaflex-1a will not be accepted.

2.8 Above-Ground Pipes:

A. Interior: Match tank interior coating schedule

B. Exterior: Match tank exterior coating schedule

2.9 Buried Pipes and Fittings:

A. Interior: Match tank interior coating schedule

B. Exterior:

1. Surface preparation: SSPC-SP10 Near-White Blast
2. Coal tar epoxy coating, min. 10 mil DFT, Tnemec Series 46H-413.
3. Wrap buried pipes with wax-applied tape coating, manufactured and installed in accordance with AWWA C217, applied with a minimum overlap width of 1-inch and a total coating thickness shall be a minimum of 80 mils. Prior to wax-tape, a thin coat of wax-tape primer must be applied. Provide tape coating in addition to coal tar epoxy coating.

PART 3 EXECUTION

3.1 GENERAL

A. All surface preparation, coating and painting shall conform to applicable standards of the Society for Protective Coatings, NACE International and the manufacturer's printed instructions. Materials applied to the surface prior to the approval of the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the Contractor.

B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be coordinated with the Engineer.

C. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign and change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the coating or paint must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.

E. Coating and painting systems include surface preparation, prime coating and finish coatings. Unless otherwise approved in writing by the Engineer, prime coating shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the specified finish coat. Any off-site work which does not conform to this specification is subjected to damage during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire-brushing, hand or power tool cleaning, or dry air blast cleaning. In order to prevent injury to surrounding painted surfaces, blast cleaning may require use of lower air pressure, smaller nozzle and/or abrasive blast particles, or shorter blast nozzle distances from surface shielding and masking. If damage is too extensive or uneconomical to touch-up, the entire item shall be blasted and then coated or painted as directed by the Engineer.

F. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Contractor's equipment shall be subject to approval of the Engineer.

G. Application of the first coat shall follow immediately after surface preparation and cleaning and stripe coat, if applicable, before rust bloom occurs or the same day, whichever is less. Any cleaned areas not receiving first coat within this period shall be recleaned prior to application of first coat. Use of dehumidification equipment shall be first reviewed by the Engineer and coatings manufacturer prior to deviating from this provision.

H. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

I. If the recoating time window stipulated by the coating manufacturer for any primer or intermediate coat is exceeded, the primer or intermediate coat shall be scarified by sweep blasting per SSPC-SP7/ NACE No. 4 to achieve the surface condition necessary to receive and properly adhere to subsequent finish coats.

3.2 SURFACE PREPARATION

A. The latest revision of the following surface preparation specifications of the Society for Protective Coatings (SSPC) shall form a part of this specification. The summaries listed below are for informational purposes; consult the actual SSPC specification for full detail.

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to a degree specified by hand chipping, scraping, sanding and wire-brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter by power wire-brushing, power impact tools or power sanders.

4. White Metal Blast Cleaning (SSPC-SP5/NACE No. 1): Air blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.

5. Commercial Blast Cleaning (SSPC-SP6 NACE No. 3): Air blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-Off Blast Cleaning (SSPC-SP7 NACE No. 4): Air blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter to a degree specified.

7. Near-White Metal Blast Cleaning (SSPC-SP10 NACE No. 2): Air blast cleaning until at least 95% of each element of surface area is free of all visible residues.

8. Power Tool Cleaning to Bare Metal (SSPC-SP11): Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile not less than 1 mil.

B. Slag, weld metal accumulation and spatters not removed by the Fabricator, Erector or Installer shall be removed by chipping and/or grinding. All sharp edges shall be peened, ground or otherwise blunted as required by the Engineer. All grinding and finishing of welds, edges, etc. shall be performed prior to solvent cleaning and abrasive blasting.

Welds shall be prepared as per NACE Standard RP0178 for all interior and exterior surfaces:

1. Butt Welds: Shall be ground smooth and free of all defects, designation "D".
2. Lap Welds: Shall be ground smooth and blended, designation "D".
3. Fillet Welded Tee Joint: Shall be ground smooth and blended, designation "D".

C. All recycled abrasives used in automated shop blasting shall be clean as per SSPC-AB2 "Cleanliness of Recycled Ferrous Metallic Abrasives". All shop blasting utilizing centrifugal-type equipment shall utilize a blend of shot and grit (maximum of 80% shot). In no case shall steel shot alone be permitted. After blast cleaning, the surface of the steel shall appear angular and irregular. Should the surface appear peened or undulating, the steel shall be reblasted to achieve the correct appearance.

D. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed. Blast nozzles shall be venturi-type nozzles with a minimum pressure at the nozzle of 90 psi.

E. Particle size of abrasives used in blast cleaning shall be selected to produce the surface profile specified above or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.

F. All shop-primed surfaces shall receive a uniform and thorough sweep-blast as per SSPC-SP7/NACE No. 4. All bare metal areas shall be abrasive blasted as per SSPC-SP10/NACE No. 2 Near-White Blast Cleaned for interior surfaces. All bare metal areas shall be abrasive blasted as per SSPC-SP6/NACE No. 3 Commercial Blast Cleaned for exterior surfaces.

G. If the profile of the blasted steel exceeds the profile specified above, the Contractor shall be required to do one or both of the following:

1. Reblast the surface using a finer aggregate in order to produce the required profile.
2. Apply a thicker prime coat, if possible given the limitations of the products being applied, in order to adequately cover the blast profile

H. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved in writing by the Engineer.

I. During blast cleaning operations, caution shall be exercised to ensure that existing coatings or paint are not exposed to abrasion from blast cleaning.

J. Contractor shall keep the area of his work and the surrounding environment in a clean condition. Contractor shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities or to the surrounding environment.

K. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. All surfaces shall be free of dust, dirt, and other residue resulting from the abrasive blasting operation. No coatings or paint shall be applied over damp or moist surfaces.

L. Brush-Off Blast surfaces coated with zinc-rich materials to remove any contamination prior to subsequent coats, per SSPC-SP7/ NACE No. 4.

M. Pitted areas on the tank interior shall be repaired by welding. Metal components exhibiting excessive pitting, as determined by the NACE Inspector, shall be rejected.

N. Specific Surface Preparation: Surface preparation for the specific system shall be as noted in Articles 2.4 and 2.5.

O. Sandblasting waste shall be disposed of off-site at an approved solid waste facility, at the Contractor's expense.

3.3 NON-VISIBLE CONTAMINANTS

A. Chloride, sulfate and ferrous ions (Fe^{2+}) tests shall be performed on the interior metal portions of the tank after sandblasting but prior to the application of coatings.

1. Perform a minimum of two tests per 1,000 square feet.

2. The maximum allowable limit of these non-visible contaminants is:

a. The maximum level of chlorides is 30 milligrams per square meter or 3 micrograms per square centimeter.

b. The maximum level of sulfates is 100 milligrams per square meter or 10 micrograms per square centimeter.

c. The maximum level of ferrous ions (Fe^{2+}) is 50 milligrams per square meter or 5 micrograms per square centimeter.

B. If testing shows amounts present in the test solution to be greater than the limits listed herein, the Contractor shall clean the surface of the entire tank interior with a 5,000 psi water blast with fine entrained abrasive until the levels in the test solutions are below the maximum acceptable level. Alternate cleaning methods may be allowed with prior approval of the Engineer. Surface shall be reblasted as specified in Articles 2.4 and 2.5 at no additional cost to the Owner.

C. Contractor shall provide a written statement from paint manufacturer stating that the maximum acceptable levels are not less than those listed herein. Results of the testing shall be provided to the Engineer before any coatings are applied.

3.4 APPLICATION, GENERAL

A. Coating and paint application shall conform to the requirements of the Steel Structure Painting Council Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting".

B. Thinning shall be permitted only as recommended by the manufacturer and approved by the Engineer, and utilizing the thinners stated in Articles 2.4 and 2.5.

C. Protective coverings or drop cloths shall be used to protect floors, fixtures and equipment. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Report to the Engineer surfaces from which materials cannot be satisfactorily removed.

D. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass

or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.

E. Care shall be taken so as to eliminate overspray and dry spray on the tank interior. Where such conditions are encountered, the surface shall be cleaned of all over spray and dry spray prior to the application of the succeeding coat.

F. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.

G. Film thickness per coat as specified in NTUA Technical Specification, Water Storage Tank Renovation, Revision 1.5 or latest shall be followed. Do not exceed the maximum allowable film thickness as it can affect curing.

H. Field-applied primer shall require a minimum 12-hour curing period after application in an environment maintained at between 20% and 40% humidity.

I. Full prime coat may be applied directly over stripe coat while stripe coat is wet.

J. Areas rendered inaccessible after tank erection such as the spaces between roof plates and rafters shall receive the full coating system prior to erection and/or assembly.

3.5 DISINFECTION

A. Disinfection of interior surfaces shall be performed in the presence of the Engineer in accordance with all the requirements of Section 33 13 13 - Water Storage Tank Disinfection and applicable AWWA standards and regulatory agencies.

B. Disinfection shall be performed after protective coatings have been applied to the interior surfaces and allowed to thoroughly cure.

C. Prior to disinfecting, the complete interior shall be washed down with clean water and thoroughly flushed out.

3.6 SOLVENT VAPOR REMOVAL

A. All solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing tank in operating service.

B. All solvent vapors will be exhausted both during and after coating application as per AWWA D102.

C. Ventilation shall be continued until such time as the coating has reached “full cure” as specified by the coating manufacturer.

3.7 VOC TEST

A. After the tank has reached “full cure” as specified by the coating manufacturer, VOC tests shall be performed on the tank interior coating system. Samples shall be collected for testing by the Owner or his representative. Tests shall be performed in accordance with EPA 524.2 Revision 4 Purgeable VOCs by GC/MS. Total VOCs shall not exceed 100 ppb/100 micrograms per liter for 24 hour and 72 hour intervals.

B. If the limits cited herein are exceeded, Contractor shall take all actions necessary to reduce the total VOCs to the level specified herein. This includes but is not limited to continuing forced air ventilation, steam cleaning the structure, and rinsing the structure with clean potable water.

3.8 CLEAN UP

A. Upon completion of the work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Coating or paint spots or oil stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired or refinished to the satisfaction of the Engineer at no cost to the Owner.

END OF SECTION

SECTION 22 11 05

CHLORINATION FACILITY PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chlorination building water piping.
2. Unions and flanges.
3. Ball valves.
4. Check valves.
5. Pipe hangers and supports.
6. Sleeves.
7. Water pressure gauges.
8. Electronic control valves.
9. Air valves.
10. Pressure relief valves.
11. Hose bibs and sample cocks.
12. Booster pumps.
13. Tapping Saddles.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
2. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
3. Section 31 23 23 - Backfill: Requirements for backfill to be placed by this section.
4. Section 33 11 13 - Public Water Distribution Systems: Product and execution requirements for underground water piping.
5. Section 33 13 00 - Disinfection of Water Distribution: Product and execution requirements for disinfection of water piping.
6. Section 44 44 16 - Chlorination Equipment.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

2. ASME B31.9 - Building Services Piping.

B. American Society of Sanitary Engineering (ASSE):

1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
5. ASSE 1019 - Performance Requirements for Wall Hydrants, Freezeless, Automatic Draining, AntiBackflow Types.

C. American Society for Testing and Materials International (ASTM):

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
5. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
7. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
8. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
9. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
12. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Water Works Association (AWWA):

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C651 - Disinfecting Water Mains.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
8. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
9. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
10. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

F. NSF International Standard / American National Standard (ANSI)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Submittal procedures.

B. Product Data:

1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

5. Pumps: Submit pump type(s), capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on metallic and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 General

A. All materials in contact with water shall be NSF61-certified.

B. All bolts, nuts, and washers in chemical room shall be stainless steel 304, and shall be confirmed by the valve or fitting manufacturer as suitable for use with their respective components.

2.2 CHLORINATION BUILDING WATER PIPING

A. Steel Pipe: Refer to Section 33 11 13 – Public Water Transmission Systems.

B. Ductile Iron Pipe: Refer to Section 33 11 13 – Public Water Transmission Systems.

C. Polyvinyl Chloride (PVC): Schedule 80, ASTM D1785, at locations indicated on Drawings.

1. Fittings: PVC Schedule 80 per ASTM D2467.

2.3 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:

1. Steel Piping: Class 150, malleable iron, threaded.
2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
3. PVC Piping: PVC.

B. Flanges for Pipe 2-1/2 inches and Larger:

1. Steel Piping: Class 150, forged steel, slip-on flanges.
2. Ductile Iron: Class 125 flanges
3. Copper Piping: Class 150, slip-on bronze flanges.
4. PVC Piping: PVC flanges.
5. CPVC Piping: CPVC flanges.
6. Gaskets: 1/16 inch thick preformed neoprene gaskets.

C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.4 BALL VALVES

A. Stainless steel ball valves

1. May be imported or domestic
2. Manufacturers:
   a. Milwaukee Valve.
   b. Apollo
   c. Red White Valve Corp.
   d. Stockham
3. Working Pressure: Not less than 350 psi
4. Inlet/Outlet: NPT, or as shown on Drawings
5. All stainless steel construction, including body, tailpiece, ball, ball retainer, stem, handle, handle nut, packing nut, and lock washer
6. Valve shall be actuated manually using lever-type handle, one-quarter turn to open and close. Handle length and range of motion shall allow handle to be located in most accessible location without interference with any other object.

B. 4-inch Ball Valve

1. Manufacturers:
   a. Val-Matic Valve and Manufacturing Corporation
      1) Series 4200

2) Substitutions: Approved equal.

b. Pressure Rating:

1) Rated to 150 psi full differential working pressure.

2) Shell test pressure 300 psi.

3) Leak test at 150 psi.

4) Cast iron body with cast iron ball

5) Stainless steel trim and external fasteners

c. Coating: Fusion bonded epoxy conforming to AWWA C550 and NSF 61; interior/exterior.

d. Valve Ends:

1) Flanged ends drilled in accordance with ANSI Class 125 bolt pattern.

2) Pressure rating not less than that of valve body.

e. Handle and Operator:

1) Plant service actuator with handwheel.

i. Manufacturer & model: AUMA GS100.3, OAE

ii. Size: 126:1 reduction ratio. Fully closes valve in 31 turns of handwheel.

2) Handwheel maximum rim pull shall not exceed 80 lbs.

3) Actuators shall be self-locking type able to hold valve in any intermediate position without fluttering or creeping. Actuators shall have external travel stops for open and closed position adjustment. Internal stops which require actuator cover and grease removal shall not be used.

4) Actuators shall have mechanical position stops able withstand 450 ft-lbs of input torque.

5) Open left, close right.

6) Limit switch

i. Westlock Limit Switch Model 2007.

ii. Switch shall change state when valve is 100% open.

C. PVC Ball Valves

1. Shall be used where called for on the Drawings, or for any additional ball valves required to be added to PVC piping within the chemical room.

2. Manufacturers:

a. NIBCO, Inc.

b. Spears Manufacturing Co.

c. Substitutions: Approved equal

3. True union valve ends

4. PVC Schedule 80

5. Working pressure: 150 psi

2.5 CHECK VALVES

A. Manufacturers:

1. Val-Matic Valve and Manufacturing Corporation, Surgebuster, Series 7200

2. Substitutions: Approved equal

B. Swing check valve, complying with AWWA C508

C. Shall provide 100% flow area with a maximum disc travel of 35 degrees.

D. Cv factor shall be not less than 440 for 4" valve, not less than 1,040 for 6" valve and not less than 1900 for 8" valve.

E. Working pressure rating: 250 psi.

F. The valve body and cover shall be fabricated of ductile iron conforming to ASTM A536.

G. Valve ends shall be flanged conforming to ANSI B16.1 Class 125 as indicated on Design Drawings.

H. The valve disc shall be fabricated EDPM with alloy steel and nylon reinforcement.

I. Coating: Fusion bonded epoxy conforming to AWWA C550 and NSF 61; interior/exterior.

2.6 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Carpenter & Paterson Inc.

2. Creative Systems Inc.

3. Flex-Weld, Inc.

4. Glope Pipe Hanger Products Inc.

5. Michigan Hanger Co.

6. Superior Valve Co.

7. Substitutions: Approved equal.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

E. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.

F. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamps.

G. Vertical Support: Steel riser clamp.

H. Floor Support for Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Copper Pipe Support: Carbon steel ring, adjustable, copper plate.

2.7 SLEEVES

A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

2.8 WATER PRESSURE GAUGES

A. Manufacturers:

1. WIKA

2. Substitutions: Approved equal.

B. Must conform to ANSI B40.1 and have the following characteristics:

1. Liquid filled, altitude/psi process gauge.

2. Stainless steel isolation ball valve.

3. Accuracy: 0.5% of full scale.

4. Wetted materials: 316 SS.

5. Case material: Polypropylene; safety glass window.

6. Connection: 1/4" NPT(M), bottom.

7. Dial Size: 4-1/2".

8. Mounting: Stem or surface.

9. Range: As indicated on Drawings.

2.9 ELECTRONIC CONTROL VALVES

A. Manufacturers:

1. Cla-Val, Model 100-20A/PE/631-22/610-01-R FHBYCSKCPP-X105LCW-N-X as supplied by Pipestone Equipment.

2. Substitutions: Not permitted.

B. Furnish materials in accordance with most recent edition of New Mexico Public Works Standards, with latest revisions.

C. Main Valve Required Features:

1. Size per Construction Drawings
2. Angle Pattern
3. Reduced Port
4. Single Chamber
5. ANSI B16.42 Class 150 Flanges
6. Working Pressure 250 psi
7. Ductile Iron Body
8. Fusion Bonded NSF Epoxy Coating
9. Stainless Steel Internal Trim
10. X105LCW Closed Position Limit Switch

D. Pilot System General Features

1. Isolation Cocks in each Independent Pilot System
2. Stainless Steel Fittings
3. Stainless Steel Braided Hose
4. Stainless Steel Wye Strainer with ball valve blowdown for all functions
5. Stainless Steel Pilots Except Model CDS6A
6. Upstream & Downstream X141-BA Pressure Gauge Package (0-60 psi inlet, 0-60 psi outlet) with Bleed Valves
7. Speed control functions identified below can be combined

E. Normal Operating Pilot System - Model 631-22 Electronic Interface Control

1. 120 VAC solenoids
2. Opening Speed Control – 60 seconds
3. Closing Speed Control – 120 seconds
4. With VC-22D controller mounted in a NEMA 4X enclosure
5. Strainer in pilot tubing
6. Close on loss of power
7. Pilot system will have an atmospheric drain.
8. Pilot system will have an independent supply pressure

F. Independent Model 610-01 One-Way Altitude Hydraulic Pilot System:

1. Normally isolated from service

2. Model CDS6A Hydraulic altitude pilot shall have a bronze body and an adjustable spring range of 5-40 ft, factory set at 18 ft.
3. Pilot system will have an atmospheric drain.
4. Pilot system will have an independent supply pressure
5. Opening Speed Control – 60 seconds
6. Closing Speed Control – 120 seconds
7. Model "R" Reservoir Feature for Setpoint Adjustment and Troubleshooting

2.10 AIR VALVES

A. 1-inch Combination Air Valve (Single Body Type):

1. Manufacturer:
   a. Val-Matic Valve and Manufacturing Corporation. Single-Body Type.
   b. Combination air valve model 201C.2 SV.
   c. Substitutions: Not permitted
2. Working pressure: 300 psi
3. Valve Size: 1"
   a. Inlet: 1" NPT
   b. Outlet: 1" NPT
   c. Orifice Size: 5/64"
4. Cast iron or ductile iron body, cover and baffle; stainless steel trim, float, and fasteners.
5. Seat: Resilient Buna N.
6. Internal and external coatings shall be fusion bonded epoxy conforming to NSF-61 requirements.
7. External fasteners shall be stainless steel

2.11 PRESSURE RELIEF VALVES

A. Manufacturers:
   1. Watts, Model BP30.
   2. Substitutions: Approved equal.

B. Bronze body with NPT threaded male inlet and NPT threaded female (drain) outlet connections, stainless steel spring and test lever.

C. Pressure relief setting as indicated on Drawings or as directed by Engineer.

2.12 HOSE BIBS AND SAMPLE COCKS

A. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel lock shield and removable key, integral vacuum breaker in conformance with ASSE 1011.

B. Interior Mixing: Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with hand wheels, and vacuum breaker in conformance with ASSE 1011.

2.13 BOOSTER PUMPS

A. Booster Pump (chemical room):

1. Pump Manufacturers:
    a. Franklin: ModelBT4 5JBT03S4
    b. Substitutions: Not permitted.
2. Flow Range: Up to 8 gpm.
3. Operating Duty Point: 2gpm @220’ TDH.
4. Cast iron discharge housing and suction bracket.
5. Thermoplastic impellers and diffuser, floating eye seal, ceramic shaft sleeve, rubber discharge bearing.
6. Stainless steel shell and shaft.
7. Maximum Water Temperature: 120 degrees F.
8. Maximum Operating Pressure: 500 psi.
9. Capable of up to 75 psi incoming pressure and 10 feet of suction lift.

B. Booster Pump (control room):

1. Manufacturers:
    a. TP Pump Model # TPA-CM1-4-AUTO
    b. Substitutions: Approved equal.
2. Components:
    a. Pump, CM1-4 A-S-E-AQQE
    b. Motor, 1 HP, 115/230 VAC
    c. Thermal overload switch
    d. Discharge-side check valve
    e. Discharge pressure switch
        1) Sensor located downstream of check valve
        2) Set-points: 30-50 psi
    f. Discharge pressure gauge

3. Rated flow: 8.8 gpm
4. Rated head: 114 ft TDH
5. Max Working Pressure: 232 psi
6. Motor Power: 0.8 HP
7. Maximum Water Temperature: 104 degrees F.
8. Maximum Suction Lift: 26 feet.
9. Stainless steel pump housing.
10. Suction side connection: 1-inch NPT
11. Discharge side connection: ¾-inch NPT (downstream side of discharge manifold)
12. Electrical Supply: 1 x 115V or 1 x 230V.

2.14 HYDROPNEUMATIC PRESSURE TANK:

A. Manufacturers:
   1. Well-X-Trol WX-103
   2. Substitutions: Approved equal.

B. Steel shell with polypropylene liner

C. Heavy duty butyl rubber diaphragm

D. Capacity: 7.6 gallons

E. Max. working pressure: 150 psi

2.15 TAPPING SADDLES

A. Tapping Saddles:
   1. Manufacturers:
      a. Romac Industries, Inc
      b. JCM Industries, Inc
      c. Substitutions: Approved equal.
   2. Saddles shall only be used on taps 2-inches or smaller.
   3. Chlorinator Room Taps: Stainless steel tapping saddles, JSM 502, OAE, heavyweight treaded outlet, full band type, with full circumferential SS band, 8” width stainless steel band.
   4. Control Room Taps: Nylon coated ductile iron tapping saddles, Romac 202-NS, OAE, with stainless steel dual compression straps.
   5. All saddles shall be specifically designed for use on the type of pipe that is being tapped.
   6. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

7. Minimum Working pressure rating: 200 psi.
8. Tapped Outlet: FNPT or as indicated on Drawings
9. All pipe taps shall be made with an engineer approved “tapping machine”.
10. Threadolets, where called for on Drawings, shall be welded to the pipe, ground, and blasted (if possible) prior to applying fusion-bonded epoxy coating to the pipe.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end steel pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Inserts:

1. Provide inserts for placement in concrete forms.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

B. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708 and MSS SP 89.
2. Support horizontal piping as schedule.
3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping. Support riser piping independently of connected horizontal piping.

7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping sheet lead packing between hanger or support and piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1-inch above finished floor level. Caulk sleeves.

3.5 INSTALLATION - ABOVE GROUND PIPING

A. Install non-conducting dielectric connections wherever joining dissimilar metals.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

D. Group piping whenever practical at common elevations.

E. Slope piping and arrange systems to drain at low points.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not accessible.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Provide support for utility meters in accordance with requirements of utility companies.

K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

L. Paint all steel pipe and uncoated ferrous appurtenances blue:

1. Minimum surface preparation: SSPC-SP1
2. Primer: 1 coat Sherwin Williams Galvite HS, OAE
    a. 3.0-4.5 mils dry film thickness

3. Finish: Two coats Sherwin Williams Industrial Enamel (B54 Series), OAE
    a. 2.0-4.0 mils dry film thickness
4. Follow all other paint manufacturer recommendations for preparation and application.

M. Install domestic water piping in accordance with ASME B31.9.

N. Sleeve pipes passing through partitions, walls and floors.

O. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

P. Install unions downstream of valves and at equipment or apparatus connections.

Q. Install valves with stems upright or horizontal, not inverted.

R. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

S. Install gate ball or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers, if applicable.

T. Install globe ball or butterfly valves for throttling, bypass, or manual flow control services, if applicable.

U. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

V. Provide spring loaded check valves on discharge of water pumps, if applicable.

W. Provide flow controls in water circulating systems as indicated on Drawings, if applicable.

X. Install potable water protection devices on plumbing lines where contamination of domestic water may occur.

Y. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

3.6 INSTALLATION – BOOSTER PUMPS

A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

C. Install pumps on vibration isolators.

D. Install flexible connectors at or near pumps where piping configuration does not absorb vibration.

E. Provide line sized shut-off valve and strainer pump suction fitting on pump suction, and line sized soft seat check valve, balancing valve, and shut-off valve combination pump discharge valve on pump discharge.

F. Decrease from line size with long radius reducing elbows or reducers, if applicable. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

G. Provide air cock and drain connection on horizontal pump casings.

H. Provide drains for bases and seals.

I. Check, align, and certify alignment of base mounted pumps prior to start-up.

J. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.

K. Lubricate pumps before start-up.

3.7 CLEANING

A. Prior to starting work, verify system is complete, flushed and clean.

B. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

C. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

D. Maintain disinfectant in system for 24 hours.

E. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

F. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

G. Take samples no sooner than 24 hours after flushing and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 22 11 35
PRE-MANUFACTURED BOOSTER PUMP SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish and install two (2) factory-built, above-grade, water booster pumping stations. The pump stations shall be complete with all the necessary internal piping, pumps, motors, valves, control, and other necessary appurtenances installed on fabricated steel bases and enclosed in structures as shown on the plans and specified herein. The pump stations shall be designed and constructed to the extent possible to HI standards and tested in accordance with relevant criteria set forth by the Hydraulic Institute (HI).

B. The pre-fabricated water booster stations shall be complete to the extent specified herein and shall not require field assembly other than those items listed in Part 3.5.

C. Related Sections:

1. Section 27 43 30 – SCADA Telemetry System
2. Section 33 11 13 - Public Water Transmission Systems.
3. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 QUALITY ASSURANCE

A. The equipment and materials covered by these specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the contract drawings and operated in accordance with the manufacturer's recommendations.

B. The manufacturer of the selected equipment shall be regularly engaged in the manufacture, assembly, construction, start-up and maintenance of water distribution equipment of the type required for this project.

C. The manufacturer shall have at least ten years of successful experience in providing stations of the type, design, function and quality as required for this project.

D. The pump station manufacturer shall affix an Underwriters Laboratories (UL) label attesting to its compliance with the UL-QCZJ standard for packaged pumping systems.

E. The station manufacturer shall provide warranty for the station against defects in quality and workmanship for a period of at least one year from the date of 1 year post start up not to exceed 24 months from date of delivery.

1.3 COORDINATION

A. Contractor shall coordinate with the pump station supplier, as well as make own measurements of owner-supplied equipment, to determine actual dimensions, locations and elevations of pump station structure, electrical and piping connection prior to construction of foundation or yard piping connections.

B. Contractor shall coordinate with the pump station supplier regarding start-up services to be provided by the supplier and ensure required Contractor's personnel and equipment are available.

C. Electrical contractor shall coordinate with pump station supplier regarding site-installed equipment on and within the prefabricated pump station.

D. Contractor shall coordinate with both pump station manufacturer's representative and surge tank manufacturer's representative to schedule start-up and allow for simultaneous start-up and testing of both pieces of equipment.

1.4 SUBMITTALS

A. Submit separate and distinct submittal packages for Pumping Plant 12 (PP12) and Pumping Plant 13 (PP13).

B. The equipment submittal shall have the name of the project and the equipment manufacturer's representative listed on the front cover.

C. The submittal shall contain an 11" x 17" mechanical drawing. The mechanical drawing shall be specific to this project and provide at least three different views. The drawing shall illustrate the National Electrical Code (NEC) clearances per Section 110-26 of the code. The submittal booklets will be complete with data sheets covering all individual components that make pump the booster pump station and the UL file number under which the manufacturer is listed.

D. Submittals shall include the following:

1. 11" x 17" Mechanical drawing
2. Booster pump station manufacturer's warranty
3. Catalog cut sheets on each individual component that comprise the pump station.
4. Copy of the manufacturer's UL label.
5. Detailed sequence of operation.
6. Complete set of wiring schematics.
7. Drawing of Control Panel Layout
8. Color charts and/or finish samples

E. Operation and Maintenance Manuals shall be in addition to any instruction or parts lists packed with or attached to the equipment when delivered. Electronic manuals shall be supplied promptly following shipment of the station.

1.5 BOOSTER PUMPING STATION DESIGN CRITERIA

NOTE: These design conditions include an assumed pump station internal head loss of 25-ft. Pump station manufacturer is wholly responsible to determine actual internal head losses and adjust the pumping head conditions listed below accordingly.

A. Pumping Plant 12 Design Criteria

PP12 Total Station Design Flow with Reach 10.2.1 Operational	1,571 GPM
PP12 Total Station Design Flow with Reach 10.2.1 Not Operational	1,346 GPM
Number of Pumps	3 - Triplex (2 pumps operating simultaneously, one on standby)
Maximum Suction Working Pressure	14 PSI
Minimum Suction Working Pressure	8 PSI
PP12 Pressure Boost @ Design Flow	482 to 542 feet
PP12 Maximum Discharge Pressure	228 PSI
PP12 Operating Elevation	6,068 ft MSL

B. Pumping Plant 13 Design Criteria

PP13 Total Station Design Flow	1,346 GPM
Number of Pumps	3 - Triplex (2 pumps operating simultaneously, one on standby)
Maximum Suction Working Pressure	15 PSI
Minimum Suction Working Pressure	6 PSI
PP13 Pressure Boost @ Design Flow	475 to 517 feet
PP13 Maximum Discharge Working Press	231 PSI
PP13 Operating Elevation	6,498 ft MSL

1.6 SEQUENCE OF OPERATION

A. All VFDs shall be equipped with Hand-Off-Auto switches. The following control modes ("Auto" and "Hand") refer to the settings of these H-O-A switches.

B. H-O-A Switch in "Auto"

1. Speed Control Logic

a. Constant Speed Mode

1) When in Constant-Speed Mode, the speed of the VFD-driven pump motor shall be adjusted by the PLC's PID controller, which is placed in manual. The SCADA (remote control) or the station operator via the HMI (local control) shall make necessary speed reference adjustments by writing the values into the PLC's manual speed register.

2) The VFD's speed shall ramp up upon starting and ramp down upon shut-down as described below.

b. Constant Pressure Mode

1) When in Constant Pressure Mode, the speed of the VFD-driven pump motor shall be adjusted by the PLC's PID controller, which shall modulate its output in order to satisfy the systems discharge pressure set-point.

2) When discharge pressure is equal to the system's discharge pressure set-point (plus or minus deadband), the PID shall hold its last output value, keeping the VFDs at their current speed. If the discharge pressure goes above this set-point (plus deadband), the PID shall start reducing its output, thereby slowing down the VFD's speed. If the discharge pressure goes below this set-point (minus deadband), the PID shall start to increase its output, thereby causing an increase in the VFD's speed. This constant modulation is done in order to vary the VFD's speed to meet system demand and maintain system's discharge pressure set-point. A deadband adjustment is provided to freeze the output of the PID at its current level whenever the discharge pressure enters a deadband range around the discharge pressure set-point.

3) The VFDs speed shall ramp up upon starting and ramp down upon shut-down as described below.

2. Pump Starting & Shut-Down Logic

a. Remote Control

1) The station controller receives tank levels (receiving and supply tanks) from the SCADA. These levels shall be displayed on the HMI screen.

2) When the station's control system is set to "Remote", the controller shall enable the pumps when the receiving tank level drops below an adjustable low-level set-point, and shall disable

the pumps when the receiving tank level exceeds an adjustable high-level set-point.

a) The receiving tank level set-points are adjustable remotely by SCADA or locally by the operator using associated HMI screens.

3) Operating mode can be toggled between "Constant Pressure Mode", and "Constant Speed Mode" from the SCADA.

4) Constant Pressure and Constant Speed set points can be adjusted from the SCADA.

5) Operator may start and stop pumps manually from SCADA, provided no alarm or fault condition exists which disables the pumps.

6) If no change in mode or set-point is received from SCADA, then mode and set points shall remain at their previous values.

b. Local Control

1) Operator may start and stop pumps manually from SCADA, provided no alarm or fault condition exists which disables the pumps.

2) System may operate in Constant Speed or Constant Pressure mode, as described above, when in Local Control. All functions other than enable/disable signals or set-point adjustments entered via the HMI shall be controlled by the pump station PLC.

3) Operating mode can be toggled between "Constant Pressure Mode", and "Constant Speed Mode" from HMI.

4) Pressure and Maximum Speed set points can be adjusted from the HMI.

5) If no change in mode or set-point is received from HMI, then mode and set points shall remain at their previous values.

3. Ramp-up/ Ramp-down:

Regardless of which speed control mode or which starting/ shut-down control is used, the VFD's speed shall ramp up to its operating speed gradually upon starting over a period of not less than 210 seconds, as measured from the time the VFD reaches the speed at which flow begins to the time the pump reaches its working speed. Upon shut-down, the pump shall ramp down over a period of not less than 210 seconds, as measured from the time the VFD begins decreasing from the working speed to the time the pump reaches no flow.

a. The "working speed" shall be either the constant-speed set-point (if in Constant Speed Mode), or the speed governor's maximum allowable speed, whichever is lower.

4. Alternation:

a. Alternation shall occur at the end of a pumping cycle. The HMI shall display the current alternation sequence (lead/standby).

b. The HMI shall be programmed to allow an alternation sequence lock, in order to keep from alternating at the end of each pump cycle. The operator shall have the ability to lock in the alternation sequence, as well as turning the pump's HOA switch in the off position and turning off the pump's circuit breaker before attempting any maintenance on the equipment.

c. In the event of a fault or alarm condition that disables one, but not both, of the pumps, the alternation sequence shall automatically adjust to skip the disabled pump and operate only the enabled pump.

5. Set-Point Adjustments:

a. The HMI shall have password protected set-up screens and pop-up keypads to adjust set-points and time delays.

b. In Constant Pressure mode, the displays shall show actual pressure and pressure set-point. The pop-up key-pad shall adjust discharge pressure set-point.

c. In Constant Speed mode, the displays shall show actual speed reference being sent to the running VFD and the adjustable manual speed reference set-point. The pop-up key-pad shall adjust the manual speed reference.

d. The set-up screens and pop-up keypads shall require a security code prior to allowing adjustments, to prevent inadvertent or unauthorized changes to set-points.

6. kW Governor:

The PLC monitors the running VFD's kW output. Should the kW equal the adjustable "kW Limit" set-point, the PLC will hold the speed reference output at its current level, by freezing the active PID's CV value (or manual speed reference value). Should the kW rise above the "kW Limit" set-point, the PLC will subtract the "kWGov Speed Minus %" set-point from the speed reference output incrementally every second. Once the kW output drops to equal or less than the "kWGov Reset" set-point for the for the "kWGov Reset" time delay period (adjustable), the PLC will reset the kW governor and allow for normal automatic operations to resume. The kW governor is designed to keep the operating VFD and motor within their rated horsepower (Note: The VFDs and motors are to be de-rated for operating elevation of 6,068 ft MSL).

C. H-O-A Switch in "Hand"

1. When the H-O-A switch is in "Hand", the VFD will start (provided there are no fault conditions which disable the pumps). The PLC does not control the VFD speed; the VFD speed is controlled directly by the operator via the keypad on the VFD unit.

2. Provided no alarm or fault condition exists which disables the pumps, the operator shall have the ability to take control of the pumps from the operator interface located on each variable frequency drive. The operator shall have the ability to start, stop and vary the speed of each pump.

3. Pump starts in the "Hand" position shall follow the acceleration profile provided internally by the VFD.

D. H-O-A Switch in "Off"

1. The pump will be shut down when the H-O-A on its respective VFD is in the "Off" position.

2. Pump stops in the "Off" position shall follow the deceleration profile provided internally by the VFD.

E. Maximum Speed Setting

1. Each VFD shall be programmable to allow the maximum allowable speed to be limited to a value that must be programmed upon start-up. This speed governor function shall be a function of the VFD itself, and shall limit the motor's maximum speed, regardless of control mode or H-O-A switch position.

2. The pump station manufacturer shall adjust this maximum speed setting upon start up to limit pump station flow rate to the design flow rate at the maximum design head condition. These design conditions will be provided by the Owner. Both the VFDs and the PLC/ HMI shall be programmed with this maximum allowable speed.

F. Test Bump Setting – Pump Recirculation

1. Each pump will have the ability to automatically "test bump". The test bump shall be a setting where the VFDs run each pump at partial speed for an adjustable timeframe and recirculates water to the adjacent regulating tank. The pump recirculation valve (PRSV) is located on the discharge side of the pump to provide headloss on the recirculation line. The purpose of the test bump setting is to automatically operate the pump station during periods the system is not in full operation. The test bump's initial frequency shall be 30 minutes every month. It is expected that the pump station will be in the test bump setting for up to five (5) years after construction.

G. Alarms:

All alarms which result in stopping the pumps shall initiate the ramp-down sequence described above, unless otherwise noted. Instantaneous stops are to be avoided.

1. In the event of a **pump motor adjustable frequency drive fault**, the associated pump motor will be disabled and the associated VFD alarm will be initiated. The alarm shall automatically reset or may require manual reset, depending on the fault (see VFD manual) providing the cause of the fault no longer exists. While the alarm is active, the HMI will display "VFDx Fault" and the alarm is sent to SCADA via communications.

2. In the event of a **low suction pressure**, the pumps shall be disabled and the Low Suction Pressure alarm shall be initiated, after an adjustable time delay. The alarm shall automatically reset, after an adjustable time delay, when the suction pressure returns to a safe operating level and the pumps will be re-enabled. While

the alarm is active the HMI will display a "Low Suction Pressure" alarm and the alarm is sent to SCADA via communications.

3. In the event of a **low supply tank level**, the pumps shall be disabled and the Supply Tank Low Level alarm shall be initiated, after an adjustable time delay. The alarm shall automatically reset, after an adjustable time delay, when the supply tank level returns to a safe operating level and the pumps will be re-enabled. While the alarm is active the HMI will display a "Supply Tank Low Level" alarm and the alarm is sent to SCADA via communications.

    a. The Supply Tank Low Level condition shall be triggered if the supply tank level drops below ten (10.0) feet.

    b. This alarm cannot be overridden manually.

4. In the event of a **low discharge pressure**, the Discharge Pressure Low alarm shall be initiated, after an adjustable time delay. The alarm shall automatically reset, after an adjustable time delay, when the discharge pressure is at, or above, the Discharge Pressure Low alarm set point. While the alarm is active the HMI will display a "Discharge Pressure Low" alarm and the alarm is sent to SCADA via communications.

5. In the event of a **high discharge pressure**, the pumps shall be disabled and the Discharge Pressure High alarm will be initiated, after an adjustable time delay. The alarm shall automatically reset, after an adjustable time delay, when the discharge pressure returns to a safe operating level and the pumps shall be re-enabled. While the alarm is active the HMI will display a "Discharge Pressure High" alarm and the alarm is sent to SCADA via communications.

6. In the event of a **low receiving tank level,** the Low Receiving Tank Level alarm shall be alarm shall be initiated, after an adjustable time delay. The alarm shall automatically reset, after an adjustable time delay, when the receiving tank level is at or above the low level alarm set-point. While the alarm is active the HMI will display a "Receiving Tank Level Low" alarm and the alarm is sent to SCADA via communications.

7. In the event of a **high receiving tank level**, the pumps shall be disabled and the Receiving Tank High Level alarm will be initiated, after an adjustable time delay. The alarm shall automatically reset, after an adjustable time delay, when the receiving tank level returns to a safe operating level and the pumps shall be re-enabled. While the alarm is active the HMI will display a "Receiving Tank High Level" alarm and the alarm is sent to SCADA via communications.

8. In the event of either a **discharge pressure transmitter failure** or **suction pressure transmitter failure**, the pumps shall be disabled, after an adjustable time delay, and the associated fault shall be displayed on the HMI. The alarm shall automatically reset, after an adjustable time delay, when the faulted transmitter returns to a functioning condition and the pumps shall be re-enabled. While an alarm is active the HMI will display either "Discharge Pressure Transmitter Failure or Suction Pressure Transmitter Failure" alarm, depending on the faulted transmitter and the associated alarm is sent to SCADA via communications.

9. In the event of a **SCADA fault**, (as monitored by the SCADA heartbeat signal to the station's controller) the SCADA alarm will be initiated, after an adjustable

time delay. The alarm will automatically reset upon resumption of the SCADA heartbeat. While the alarm is active the HMI will display a "SCADA Fault".

a. If the system is in Remote Control upon initiation of the SCADA fault, the system will automatically shut down the pumps and revert to Local Control. The operator may manually re-start the pumps from the HMI (after overriding the warning notification described below), but they will not re-start automatically.

b. If the system is in Local Control upon initiation of the SCADA fault, the pumps will be disabled until the operator manually overrides the warning notification described below.

c. A special warning shall appear on the HMI to notify the operator that SCADA signal indicating supply tank level has been lost and the pumps have been disabled. This notification shall provide a prompt allowing the operator to override the disable in Local Control (default is not to override). If the operator chooses to override this warning, the pumps will be re-enabled in Local Control only.

d. Upon resumption of SCADA heartbeat, the system will <u>not</u> automatically return to Remote Control. The operator must tell the system to switch back from Local to Remote Control, either via SCADA or the HMI.

e. The heartbeat is visually monitored on the associated HMI screen.

f. The SCADA fault will also be initiated, as described above, if the signal indicating supply tank level is lost (even if SCADA heartbeat is still received), after an adjustable time delay.

10. In the event of a **smoke/ heat alarm**, the pumps shall be disabled and the Smoke/ Heat alarm shall be initiated. The alarm will require manual reset, remotely from SCADA or locally via the HMI, after the alarm signal from the smoke/ heat detector is removed. While the alarm is active the HMI will display a "Smoke/ Heat" alarm and the alarm is sent to SCADA via communications.

    a. Smoke/ heat alarms shall be normally-closed and wired in series.

11. In the event that an external surge tank reaches a high level, a **Surge Tank High** alarm shall be initiated, after an adjustable time delay. The alarm shall require manual reset, after the surge tank level is at, or below, the Surge Tank High alarm set point. While the alarm is active the HMI will display a "Surge Tank High" alarm and the alarm is sent to SCADA via communications.

    a. The alarm displayed on the HMI and sent to SCADA shall specify which tank is in alarm condition.

12. In the event that an external surge tank reaches a level of less than 10% full, a **Surge Tank Low** alarm shall be initiated, after an adjustable time delay. The alarm shall require manual reset, after the discharge pressure is at, or above, the Surge Tank Low alarm set point. While the alarm is active the HMI will display a "Surge Tank Low" alarm and the alarm is sent to SCADA via communications.

    a. The alarm displayed on the HMI and sent to SCADA shall specify which tank is in alarm condition.

H. System Inputs/ Outputs

1. The station controller shall make following outputs available to SCADA and the HMI, in addition to any other outputs required to operate the system as specified herein:
    a. VFD Output Voltage
    b. VFD Output Frequency
    c. VFD Output Current
    d. VFD Output kW
    e. VFD Speed
    f. Station and Individual Pump Run Status
    g. Station Fault Log (Available on HMI only, SCADA will need to log faults independently)
    h. All Station Alarms and Fault Codes
    i. All alarm level set-points
    j. Suction Pressure
    k. Discharge Pressure
    l. Flow Rate
    m. Flow Totalized (Available on HMI only, SCADA will need to totalize flow independently
    n. Supply tank pump start, pump off, and alarm set-points
    o. Receiving tank pump start, pump off, and alarm set-points
    p. Constant-Pressure Set Point
    q. Constant-Speed Set Point
    r. Constant Pressure or Constant Speed mode
    s. Local or Remote Control
    t. Hand or Automatic Control
    u. Pump station smoke/ heat alarms
    v. Pump station intrusion alarms
    w. Control power available (not on battery back-up)
2. The station controller shall receive the following external outputs from the adjacent surge tank building's PLC and pressure transmitters at the regulating tank and retransmit them to SCADA and the HMI:
    a. Surge tank building smoke alarm
    b. Surge tank building intrusion alarm
    c. Discharge side surge tank differential pressure transmitter (transmitted and displayed as % full)
    d. Regulating Tank levels (transmitted and displayed as level in feet)

3. The station will receive the following inputs from SCADA and the HMI, in addition to any other inputs required to operate the system as specified herein:
    a. SCADA health/ heartbeat (SCADA only)
    b. Remote vs. Local Control
    c. Constant Speed vs. Constant Pressure Speed Control Mode
    d. Constant Speed set point
    e. Constant Pressure set point
    f. Receiving tank level (SCADA only)
    g. Receiving tank pump off level set-point
    h. Receiving tank pump start level set-point
    i. Receiving tank transmitter fault
    j. Supply tank level – hardwire to regulating tank pressure transducer
    k. Supply tank pump off level set-point
    l. Supply tank pump start level set-point
    m. Supply tank transmitter fault
4. All I/O modules shall have a minimum of 10% spare capacity for additional I/Os.

PART 2 PRODUCTS

2.1 All components in direct contact with process water shall be NSF 61 certified.

2.2 MANUFACTURERS

A. The pre-manufactured pump station shall be manufactured by one of the following:
    1. Dakota Pump
    2. Substitutions: Must be approved in writing by the Navajo Tribal Utility Authority (NTUA) prior to bid opening. The burden of obtaining NTUA approval shall rest entirely upon the party seeking the substitution.

2.3 STRUCTURAL

A. Structural Support for Above Ground Water Booster Pumping Stations
    1. The pump station shall be built on a structural steel base. The base shall provide adequate structural supports for the pumps, motors, piping and all other internal components of the station.
    2. The structural steel base shall be designed with such rigidity that the base, when lifted, will not deflect more than one inch per 180 inches of length or width.
    3. The structural steel base shall be designed to allow finished grout fill under pumps and at pipe penetrations.
    4. The structural steel base shall be designed to allow the floor to be finished with ½’ steel plate.

B. Pipe Supports

1. Pipe supports shall be designed and sized as follows:

   a. 4” And small piping shall be 2” x 2” x 3/16” wall rectangular tubing;

   b. 6” Through 12” piping shall be 3” x 3” x ¼” wall rectangular tubing;

   c. 14” Through 24” piping shall be 4” x 4” x ¼” wall rectangular tubing;

   d. All rectangular tubing shall have capped ends;

   e. Pipe supports are to be fully welded at the base. Pipe shall be supported by a saddle and shall not be welded to the support.

   f. Simple pipe stands made of pipe welded only at the flow and upholding a bracket with or without a threaded jack bolt or a U-bolt are not acceptable.

2. The structural steel base shall be provided with two floor drains as shown on the plans.

2.4 ARCHITECTURAL

A. Pump Station Enclosure

1. Codes and Standards - The structure design and manufacture shall, as a minimum, conform to ASCE (American Society of Civil Engineers) current edition of "Minimum Design Loads for Buildings and Other Structures" and to the MBMA (Metal Building Manufacturers Association) "Recommended Design Practices Manual." Building shall be manufactured and built to satisfy current editions of the International Building Code (IBC), and the National Electrical Code (NEC). Building shall be Level 4 bullet resistant as defined by UL752. Building Manufacturer shall supply plans and calculations stamped by a Registered Professional Engineer for the State where Building to be installed. The Contractor is responsible for obtaining any State Industrial Building Commission Approvals and Third Party Inspections as required by the State of New Mexico.

2. Loading - The building shall be designed to support the following loads:

   a. Roof Load - 50 PSF (40# live and 10# dead)

   b. Ceiling Dead Load - 10 PSF

   c. Wall Load - 110 mph wind, plus wall mounted equipment.

   d. Seismic Zone: Per IBC for site location.

3. A modular structure with minimum exterior dimensions as shown on the drawings shall be provided to protect the equipment, controls and operating equipment from the environment. The station building enclosure shall be a fully assembled, modular structure with wood and steel framework attached to the pump station base structure requiring no additional assembly at the job site. The dimensions shown on the drawings for the building enclosure are a minimum. The building shall be fabricated on the pump station steel base. Buildings manufactured at a remote facility requiring transportation to the booster station manufacturer’s facility will not be considered. The building shall be constructed directly on the fabricated steel base and shipped to the project site or nearest passable road as one complete unit,

requiring only unloading, placement on an approved concrete slab, connecting the underground piping and electrical service to finish the installation.

4. Wall framing will be 2" x 6" wood studs. The wood roof truss shall be a minimum of 2" x 4". The size and placement and spacing of studs and joist shall be in accordance with material standards listed below and building design criteria. At a minimum, the wall stud grade shall be SPF and shall be installed on 16" centers. The walls will include a single bottom plate and a double top plate. Metal studs and trusses will not be considered an acceptable alternate. Modular steel panel buildings are not an acceptable alternate.

5. All openings in the side walls shall be fully framed out and supported using framing members sufficient to support and fasten the equipment requiring a framed opening.

6. The building design and construction shall withstand 100 mph wind loads, to support 50 pfs live roof load, and be designed for seismic zones for the appropriate area of installation.

7. The exterior wall sheathing will be ½" CDX grade plywood. The exterior roof sheathing shall be 5/8" CDX grade plywood. The interior wall and roof sheathing will be 5/8" CDX grade plywood. OSB or particle board sheathing is not acceptable. The walls will be insulated with spray polyurethane closed cell foam to create an R-28 insulation value and the roof shall be sprayed to create an R-28 insulation value.

8. The insulation shall be applied to the walls and ceiling in 3/4" to 1 1/2" passes to create a thickness with an R-28 value minimum.
   a. The physical properties shall meet or exceed the following tests and standards:

b.	Density, (core)(pct)	ASTM D-1622	1.70-1.95
c.	Tensile Strength (psi)	ASTM D1-623 (Type C)	57-65
d.	Water Absorption, lb/sq ft	ASTM D-2842	0.02-0.05
e.	Closed Cell, Content, %	ASTM D-2856	85-95
f.	K-Factor, Initial Btu In/Hr	ASTM C-518	0.135-0.142

9. The roof shall be gabled with a center ridge line running the long dimension of the building. The roof system shall include a 3:12 minimum roof pitch with 6 - 10" overhang on all sides. The wood roof system shall include wood trusses placed 24" on center, covered with 5/8" CDX plywood. The plywood shall be covered with 30# underlayment and covered with a 26 gauge standing seam metal ribbed roof. Manufactured foam shall be installed under the raised rib. The soffits and fascia shall be manufactured of aluminum.

10. All interior surfaces will be covered with Fiberglass Reinforced Plastic (FRP) utilizing corner moldings and seam moldings. The FRP sheeting shall include a pebble grain gloss white finish. FRP panel will be applied with the appropriate glues and adhesive. Corner moldings of like FRP material shall be installed and finished in a workmanlike manner.

11. The exterior walls of the building shall be wrapped with Tyvek or equal building wrap.

12. The building shall be firmly and securely attached to the steel base structure with 3/8" lag bolts welded to the station base. This lag bolt shall be secured with a

washer and nut on the center of the bottom wall plate. A steel 1 ½" x 2" x 1/8" angle shall be welded to the station base. This angle shall mate with the inside of the building. The space between the building frame and the steel based shall include a sill sealed gasket to prevent wind and water leakage.

13. All construction will be completed inside a closed facility.

14. Materials - The materials shall be new, unused, and fabricated in a workmanlike manner in a factory environment. Hot rolled steel to meet as a minimum standard ASTM –A36, and all galvanized steel to meet as a minimum standard ASTM A - 653.

15. Exterior

    a. The exterior walls shall be sheathed with ½" CDX plywood with a deflection design no greater than L/240.

    b. A water infiltration barrier shall be provided.

    c. A veneer consisting of paintable, polymer re-enforced cement panels with an exterior finish of textured stacked block shall be applied over the ½" plywood substrate.

    d. Veneer shall carry a 5 year warranty from date of installation.

    e. Veneer shall have a minimum thickness of 1" at the block face and 9/16" at each joint.

    f. Veneer shall be Fullerton Finish Systems CastWal, or approved equal.

16. Exterior Trim - The exterior trim package shall include stepped or boxed eave, rake, fascia, base, corner, jamb, and header trim in, 26 gauge Galvalume material with Owner's choice of standard KYNAR colors.

17. Fasteners, Adhesives, and Sealants - The fasteners, adhesives, and sealants utilized shall be of types approved for use on this type of structure as required by the appropriate agency or governing body, as covered in Part 2.3A.1 of these specifications.

18. Closures - Matching, pre-molded, closed cell elastomeric closures provided by the siding and roof panel manufacturer shall be installed according to the manufacturer's recommendations at the eave line, beneath the roof panels, and where the trim meets the wall panels.

B. Doors and Hardware

1. Door Schedule

No.	Size	UL 752, Level 4 Bullet Resistant	Panic Hardware	Crash Chain & Overhead Stop
1	36" x 80"	Yes	Yes	Yes
2	72" x 80"	Yes	Yes	Yes

2. Door Design

    a. Doors shall be single or double and sized per the plan sheet.

b. Doors shall at a minimum comply with Steel Door Institute directive SDI-100.

c. Keyed, low profile rim device type panic interior openers, with cylinder lock entry and thumb latch exterior trim, by Von Duprin or equal shall be provided.

1) All doors shall be keyed with a common key.

2) Provide eight (8) original keys to Owner.

d. A heavy duty, floor mounted door closer shall be provided on all doors in order to protect the door and personnel from harm due to high winds (up to 90 mph). The door closer shall be specifically designed for doors weighing up to 1500 lbs. The closer shall be equipped with a built-in positive dead stop to prevent the door from swinging beyond the desired opening degree of 105°.

1) The closer shall feature separate and independent valves for closing speed, latch speed and backcheck. Closers shall be ASSA ABLOY Rixson model L27 or engineer approved equal. A redundant, heavy duty crash chain shall also be provided.

2) Double doors shall be equipped with panic hardware and floor-mounted closers for each leaf. Each leaf shall be able to open and close independently of the other.

e. A threshold, weather-stripping and sweeps shall be provided for each door as manufactured by Reese or equal.

f. A drip cap shall be provided for each door, extending 3” past door edge.

g. All doors, hinges and associated hardware shall be UL752, level 4 bullet resistant.

h. The doors shall be flush design manufactured of 16 gauge, grade III, extra heavy duty steel panels with flush top channel and inverted bottom channel with internal insulation to exceed R-5.

i. Each door shall be equipped with a 24 VDC magnetic switch that shall be wired back to the pump station PLC in order to provide an intrusion alarm.

j. The door frame shall be a full CF frame of 18 gauge cold formed steel and being securely fastened to the framed opening.

k. Each door (both leaves for double doors) shall have a heavy-duty cane bolt mounted on the interior side at the bottom, to be used as a door stop when the door is open. This slide bolt will fit into a steel gate stop cast into the concrete porch or driveway.

1) 5/8” diameter, 36” long, black steel cane bolt.

a) Bolt must be able to be kept in the ‘up/unengaged’ position, such that operator need not hold the bolt up as door is opened or closed.

2) Cane bolts must be factory welded to doors. Weld cane bolt assembly to steel door so as to allow 6” of throw below bottom

of door when lowed, or more to ensure full engagement with the gate stop set into the concrete porch or driveway.

3) When raised, bolt shall have the ability to be safely held slightly above bottom of door to allow the door full range of motion without contacting concrete porch or driveway.

4) Gate stop shall be a field type gate center stop (set in concrete porch or driveway), part number HS 015 913-34 (custom) as by Hardware Specialties of Albuquerque, OAE

a) 3" x 5" rectangular cold-plate steel formed with 7/8" wide, 3" long, 1" deep at center concave channel.

b) 5/8" diameter, 5" long cold rolled steel bar affixed to bottom center of plate.

C. Miscellaneous and Other

1. A one-ton capacity crane entirely supported by the ceiling trusses and building frame with trim matching interior liner panel shall be provided. Bridge cranes requiring additional supports will be considered unacceptable.
2. Gutters shall be provided of 26ga galvanized steel. They shall be mounted over eave trim on each side of the building. Both eave walls shall be provided with 1 down spout with necessary elbows.
3. A rain canopy shall be supplied and mounted by the installing contractor above the door. Minimum dimensions shall be 8' x 4' and shall be made from 14 ga. Galvannealled metal.
4. Contractor to coordinate installation of all gutter, downspout, rain canopy, and associated equipment with the pump station supplier after building has been secured to concrete slab.

D. Enclosure Accessories – The following items shall be provided by the station manufacturer:

1. Minimum Six (6) LED lights in accordance with article 2.6.D
2. Minimum Three (3) wall mounted, interior convenience outlets in accordance with article 2.6.E
3. One (1) wall mounted, exterior convenience outlet in accordance with article 2.6.E located adjacent to the HVAC unit.
4. One (1) exterior mounted weatherproof, HPS, lamp with photocell and switch, in accordance with article 2.6.D.
5. One (1) interior emergency lighting fixture in accordance with article 2.6.D
6. One (1) wall mounted, HVAC unit in accordance with article 2.6 G

2.5 MECHANICAL

A. Vertical Multistage Centrifugal Pumps

B. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.

C. The pumps shall be of the in-line vertical multi-stage design.

D. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

E. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

F. Pumping Plant 12 Design Conditions

1. NOTE: These design conditions include an assumed pump station internal headloss of 25-ft. Pump station manufacturer is wholly responsible to determine actual internal head losses and adjust the pumping head conditions listed below accordingly.

2. PP12 Model Number: CR 185-3-1 A-G-A-E-HQQE

3. PP12 Design Conditions

   a. Pump station shall be a triplex design, with two pumps operating simultaneously.
   b. The total design flowrate is 1,571 gpm.
   c. Shutoff Head: 614 ft
   d. Nominal Operating Speed: 3600 RPM
   e. Minimum Motor HP: 150 HP
   f. Motor Voltage: 480

Pumping Plant 12 Design Conditions	
Flow Condition 1 – Normal TDH with 10.2.1 Offline	
Flow Rate Total	1,347 GPM
Flow Rate per Pump	674 GPM
Head Design TDH	505 FT
Pump Speed @ Min Head Design	Per mfgr
Pump Efficiency @ Min Head Des.	79% +/-1%
Flow Condition 2 – Normal TDH with 10.2.1 Online	
Flow Rate Total	1,571 GPM
Flow Rate per Pump	786 GPM
Head Design TDH	514 FT
Pump Speed @ Min Head Design	Per mfgr
Pump Efficiency @ Min Head Des.	81% +/-1%
Flow Condition 3 – Minimum TDH	
Flow Rate Total	1,347 GPM
Flow Rate per Pump	674 GPM
Min Head TDH	482 FT

Pump Speed @ Min Head Design	Per mfgr
Pump Efficiency @ Min Head Des.	79% +/-1%
Flow Condition 4 – Maximum TDH	
Flow Rate Total	1,571 GPM
Flow Rate per Pump	786 GPM
Max Head TDH	542 FT
Pump Speed @ Max Head Design	Per mfgr
Pump Efficiency @ Max Head Des.	81% +/-1%
Flow Condition 5 – Test Bump	
Test Bump Setting	350 GPM
Test Bump Head TDH	140 FT
Pump Speed @ Test Bump	Per mfgr

G. Pumping Plant 13 Design Conditions

1. NOTE: These design conditions include an assumed pump station internal headloss of 25-ft. Pump station manufacturer is wholly responsible to determine actual internal head losses and adjust the pumping head conditions listed below accordingly.
2. PP13 Model Number: CR 185-3-1 A-G-A-E-HQQE
3. PP13 Design Conditions
   a. Pump station shall be a triplex design, with two pumps operating simultaneously.
   b. The total design flowrate is 1,346 gpm.
   c. Shutoff Head: 614 ft
   d. Nominal Operating Speed: 3600 RPM
   e. Minimum Motor HP: 150 HP
   f. Motor Voltage: 480

Pumping Plant 13 Design Conditions	
Flow Condition 1 – Normal TDH	
Flow Rate Total	1,346 GPM
Flow Rate per Pump	673 GPM
Head Design TDH	517 FT
Pump Speed @ Min Head Design	Per mfgr
Pump Efficiency @ Min Head Des.	78.5% +/-1%
Flow Condition 2 – Minimum TDH	
Flow Rate Total	1,346 GPM

Flow Rate per Pump	673 GPM
Min Head TDH	500 FT
Pump Speed @ Min Head Design	Per mfgr
Pump Efficiency @ Min Head Des.	78.8% +/-1%
Flow Condition 3 – Maximum TDH	
Flow Rate Total	1,346 GPM
Flow Rate per Pump	673 GPM
Max Head TDH	542 FT
Pump Speed @ Max Head Design	Per mfgr
Pump Efficiency @ Max Head Des.	77.8% +/-1%
Flow Condition 4 – Test Bump	
Test Bump Setting	350 GPM
Test Bump Head TDH	140 FT
Pump Speed @ Test Bump	Per mfgr

4. Pump Casing

   a. Pump casing shall be ductile iron, designed for heavy-duty service. The interior shall be smooth and free from surface defects.

   b. Thickness, diameter and drilling dimensions of suction flanges shall be Class 125 ANSI standard. Discharge flanges shall be Class 250 ANSI standard. Pump casings shall have a minimum 8" suction and a 6" discharge. Suction and discharge connections shall be located on opposite sides of the pump. The pump will be provided with an 8" suction and discharge flange.

   c. Casings shall be drilled and tapped for vertical priming, gauge, and drain connections. Suitable lifting lugs or eyebolts shall be provided.

5. Impellers

   a. Impellers shall be of stainless steel 316 smooth all over and of ample strength and stiffness for maintaining the maximum capacity of the unit.

   b. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

   c. Impeller shall be statically and dynamically balanced stainless steel 316 sleeves extended through the stuffing box. .

   d. Impellers installed in the pumps shall be capable of meeting the current design conditions specified above.

6. Shaft seal

   a. Balanced o-ring cartridge type with the following features:

      1) Collar, Drivers, Spring: 316 Stainless Steel

2) Shaft Sleeve, Gland Plate: 316 Stainless Steel
3) Stationary Ring: Silicon Carbide
4) Rotating Ring: Silicon Carbide
5) O-rings: EPDM

b. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

7. Pump Shaft

a. The shaft shall be 431 Stainless steel and of such dimensions that the maximum combined stress due to bending and torsion under the most severe conditions of operation.

b. The shaft shall be accurately machined over its entire length.

8. Pump Construction.

a. Suction/discharge base, pump head Ductile Iron (ASTM 65-45-12)
b. Shaft couplings, flange rings: Ductile Iron (ASTM 65-45-12)
c. Shaft 431 Stainless Steel
d. Motor Stool Cast Iron (ASTM Class 30)
e. Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
f. Impeller wear rings: 304 Stainless Steel
g. Intermediate Bearing Journals: Silicon Carbide
h. Intermediate Chamber Bearings: Leadless Tin Bronze
i. Chamber Bushings: Graphite Filled PTFE
j. O-rings: EPDM

9. Couplings

a. The coupling shall be Martin Quadra-flex or approved equal with type S flanges and elastomeric sleeves of Hytrel, EPDM or similar material.

b. Sized to transmit the maximum required horsepower with a 1.15 service factor.

10. Motors

a. Motors shall be NEMA design B, open drip-proof design.

b. Motors shall be Totally Enclosed, Fan-Cooled (TEFC) type

c. Motors shall be provided with Class F insulation.

d. Motors shall be rated for operation at an altitude of 6068 ft MSL.

e. Motor horsepower, RPM and voltage shall be as indicated in article 2.4.A.1.

f. The motor name plate horsepower shall be non-overloading throughout the entirety of the pump performance curve. Do not rely on the service factor to meet current or future design operating conditions.

g. Motors shall have a 1.15 service factor on sine wave power.

h. Motors shall be premium efficiency, inverter duty as defined by NEMA MG1 part 31.

i. Motor windings shall be equipped with normally-closed thermostats, wired in series with the motor windings, which open at a factory-set temperature to prevent motors from overheating.

j. Motor bearings shall be provided with grease relief ports.

H. Pipe, Valves and Fittings

1. Working pressure ratings:

a. Suction piping, valves and fittings: 150 psi min.

b. Discharge piping, valves and fittings: 300 psi min.

2. Piping

a. Piping shall be steel and conform to material specification ASTM A-53 (CW) for nominal pipe size four (4) inches and smaller, and ASTM A-53 (ERW) Grade B for nominal pipe size five (5) inches and larger.

b. Steel butt-welding fittings shall conform to material specification ASTM A-234 Grade WPB and to the dimensions and tolerances of ANSI Standards B16.9 and B16.28 respectively.

c. Forged steel flanges shall conform to material specification ASTM A-105 Class 60 and/or ASTM A-181 for carbon steel forgings and to the dimensions and tolerances of ANSI Standards B16.5 as amended in 1992 for Class 150 and Class 300 flanges.

d. Certified welders employed by the pump station manufacturer shall perform all pipe welds.

e. Piping of six (6) inches diameter and larger shall require a minimum of two (2) weld passes to complete each weld. The first pass, or root pass, shall be applied at the bottom of the bevel cut using the short circuit transfer-welding mode. The second pass, or cap pass, shall be applied over the root pass using the spray or pulse arc transfer welding modes to insure that at a minimum the total weld thickness shall be equal to thinnest of the two pieces being welded together.

f. The piping sizes shall be as shown on the drawings.

1) Size 10" and below – Schedule 40

2) Size 12" and above – Standard weight (.375" wall)

g. Piping Restraints - The main inlet and outlet piping to the station shall each be provided with two (2) or four (4) restraining points as welded on “eyes” or similar device welded to the framing to facilitate the attachment of joint restraint tie rods or other device to be used in retarding any pipe movement at the connections.

h. All interior and exterior surfaces of steel piping and fittings shall be fusion bonded epoxy coated in accordance with AWWA C213 and NSF 61.

1) Prior to blasting, grind surfaces smooth, remove weld splatter and other defects.

2) Blast to SSPC-SP5 White Blast Clean with surface profile of 2.0 to 3.0 mils.

3) Coating thickness for both interior and exterior shall be not less than 12.0 mils DFT and not more than coating manufacturer's recommended maximum thickness.

4) Coating shall be suitable for water less than 140 degrees F.

5) Minimum field adhesion: 700 psi.

6) Cure testing for fusion bonded or liquid epoxy coatings: ASTM D4752 and ASTM D3363, Every 1000 sq.ft. of epoxy coating.

3. Elastomeric Connectors

a. The inlet side of each booster pump shall include an elastomeric connector to help isolate vibration and noise in the piping system.

b. The elastomeric connector shall be of single sphere design, constructed of neoprene and nylon with bias-ply tire reinforcing cord to provide a 225 PSI working pressure rating for sizes up to and including 12" and 125 PSI working pressure rating for sizes above 12".

c. The elastomeric connector shall pass through the plate steel flanges designed to grip the connector so the connector seals without gaskets when the flange bolts are drawn up.

d. A control joint limiting pipe connector movement shall be supplied with each pipe connector.

e. The booster station piping shall include a compression type, flexible coupling to prevent binding and facilitate removal of associated equipment where shown on the plans for this item. In lieu of a compression coupling, a grooved, flexible coupling may be used.

f. NSF 61 approved.

4. Valves

a. All valves shall be interior and exterior coated with NSF 61 and AWWA-approved fusion bonded epoxy coatings (interior per AWWA C550).

b. Pump Suction Side Isolation Butterfly Valves

1) Valve Manufacturer shall be:

a) Val-Matic Butterfly Valve, Series 2000

b) Substitutions: Section 01 00 00

2) Butterfly valves shall comply with the latest revision of AWWA C504 and NSF 61.

3) Suction Side Pressure Rating: 150 psi

4) Fusion Bonded Epoxy Coated Ductile Iron valve body.

5) Ends shall be Class 150 flanges.

6) EPDM seats shall be located on the valve disc and shall provide a 360 degree continuous, uninterrupted seating surface.

7) The stainless steel shaft shall be one piece. The disc and stem shall be connected by a stainless steel taper pin that shall provide positive engagement.

8) Self-lubricating nylatron or teflon lined sleeve bearings shall be provided in the valve hubs.

9) V-type shaft seals shall be replaceable without removal of the valve from the line.

10) All hardware shall be stainless steel. Valves sized six (6”) and smaller shall be equipped with lever operator and 10-degree increment throttling plate and position indicator.

11) Valve sized eight-inches (8“) and larger shall be equipped with a weatherproof, heavy-duty, gear operator complete with a position indicator and handwheel

c. Pump Discharge Side Isolation Butterfly Valves

1) Valve Manufacturer shall be:

a) Val-Matic Butterfly Valve, Series 2000HP

b) Substitutions: Section 01 00 00

2) Butterfly valves shall comply with the latest revision of AWWA C519 and NSF 61.

3) Minimum Discharge Side Pressure Rating: 286 psi

4) Fusion Bonded Epoxy Coated Ductile Iron valve body ASTM A564 65-45-12

5) Ends shall be Class 300 flanges.

6) Body seat shall be welded nickel alloy.

7) EPDM seats shall be located on the valve disc and shall provide a 360 degree continuous, uninterrupted seating surface.

8) The high strength 17-4 stainless steel shaft shall be one piece. The disc and stem shall be connected by a stainless-steel taper pin that shall provide positive engagement.

9) Self-lubricating nylatron or teflon lined sleeve bearings shall be provided in the valve hubs.

10) V-type shaft seals shall be replaceable without removal of the valve from the line.

11) All hardware shall be stainless steel. Valves sized three (3”) and smaller shall be equipped with lever operator and 10-degree increment throttling plate and position indicator.

12) Valve sized four-inches (4") and larger shall be equipped with a weatherproof, heavy-duty, gear operator complete with a position indicator and handwheel

d. Check Valves

1) Manufacturers:

a) Val-Matic Globe Style Silent Check Valve, Series 1800

b) Substitutions: Section 01 00 00

2) Working Pressure: 400 psi

3) Valve shall be designed, manufactured and tested in accordance with AWWA C508.

4) Valve ends: Flanged, drilled in accordance with ANSI Class 250 bolt pattern.

5) The valve design shall incorporate a center guided, spring loaded disc, having a short linear stroke that generates a flow area equal to the nominal valve size. Non-slam characteristics shall be provided through a short disc stroke and heavy duty spring with a cracking pressure of 0.5 psig.

6) Valve disc: Shall be cycle tested 1,000,000 times in accordance with AWWA C508 with no signs of wear, cracking or distortion and shall remain drop tight at both high and low pressures. Disc shall be bronze and have a molded Buna N seal for drop tight operation.

7) Valve body: Constructed of ASTM A536 Grade 65-45-12 ductile iron.

8) Coating: Fusion-bonded epoxy conforming to AWWA C550 and NSF 61; interior and exterior.

e. Pressure Relief Valve

1) The pressure relief valve shall be a Cla-Val model 50-01, pilot controlled, hydraulically operated, diaphragm type automatic control valve with a X101 position indicator.

2) The pressure relief valve shall be isolated from the system with butterfly valves in accordance with these specifications.

3) The main valve shall be furnished with a resilient, replaceable seat, fusion bonded epoxy coating, and stainless steel seat ring

4) The control pilot shall be a direct acting, adjustable, spring loaded, normally closed pilot designed to close the main valve whenever the sensed pressure is below the pilot spring setting.

5) Stainless Steel pilot system shall include isolation ball valves, Y-strainer with manual blowdown, upstream pressure gauge with bleeder components, and flexible braided hose.

6) The relief valve shall function to limit the discharge header pressure to the value set into the control pilot.

7) The valve shall be sized in accordance with NFPA 20, 2007 edition, table 5.25.

8) Relief valves shall be angle or globe pattern, flanged to meet ANSI Class 150, and have a maximum pressure rating of 300 PSI.

f. Pump Station Recirculation Valve

1) The pump station recirculation valve (PSRV) shall be a Cla-Val model 50-01-KO, pilot controlled, hydraulically operated, diaphragm type automatic control valve with anti-cavitation trim.

2) The PSRV shall be isolated from the system with butterfly valves in accordance with these specifications.

3) The main valve shall be furnished with a resilient, replaceable seat, fusion bonded epoxy coating, and stainless steel seat ring

4) The PSRV shall have a normally closed 120 vac solenoid valve in the pilot system to close the main valve when de-energized. When the pump station recirculation mode is selected, the solenoid will be energized to allow flow through the valve at the pressure sustaining setpoint.

5) The control pilot shall be a direct acting, adjustable, spring loaded, normally closed pilot designed to close the main valve whenever the sensed pressure is below the pilot spring setting. Initial setpoint should be 60 psi with a field adjustable spring range of 20-105 psi. When the pump station is running in recirculation mode, the pilot shall maintain a constant backpressure on the pump.

6) Stainless Steel pilot system shall include isolation ball valves, Y-strainer with manual blowdown, opening and closing speed controls, upstream and downstream pressure gauges with bleeder components, and flexible braided hose.

7) The PSRV shall be angle or globe pattern, flanged to meet ANSI Class 150, and have a maximum pressure rating of 300 PSI.

5. Air Valves

a. All air valves shall have FBE-coated bodies, interior and exterior, SS 316 trim and float, and resilient Buna N seats.

b. Specify based on Val-Matic model numbers:

1) Val-Matic 2” combination air release valve with 3/32” orifice rated to 300 psi CWP, Model 202C.2DISV OAE.

2.6 ELECTRICAL

A. Electrical Design

1. Electrical service provided to the pump station will be 480 volt, 3 phase, 60 hertz, 4-wire wye.

2. The electrical apparatus and control panel design, assembly, and installation, and the integration of component parts will be the responsibility of the manufacturer of

record for this booster pumping equipment. That manufacturer shall maintain at his regular place of business a complete electrical design, assembly and test facility to assure continuity of electrical design with equipment application.

3. The manufacture of electrical control panels and their mounting and installation shall be done in strict accordance with the requirements of UL Standard 508A and the National Electrical Code (NEC), latest revision, to afford a measure of security as to the ability of the eventual owner to safely operate the equipment.

4. All service entrance, power distribution, control and starting equipment panels shall be constructed and installed in strict accordance with Underwriter's Laboratories (UL) Standard 508 "Industrial Control Equipment." The UL label shall also include an SE "Service Entrance" rating stating that the main distribution panel is suitable for use as service entrance equipment. The panels shall be shop inspected by UL, or constructed in a UL recognized facility.

5. Control panels shall bear a serialized UL label indicating acceptance under Standard 508A and under Enclosed Industrial Control Panel. In addition, a photocopy of the UL labels for this specific project shall be transmitted to both the Engineer and the Contractor for their permanent project files prior to shipment of the equipment covered under these specifications.

6. Each electrical equipment item in the station shall be properly grounded per Section 250 of the National Electrical Code. Items to be grounded include, but are not limited to, pump motor frames, control panel, transformer, convenience receptacles, dedicated receptacle for heater, air conditioner, lights, light switch, exhaust fans and pressure switches.

7. All ground wires from installed equipment shall be in conduit and shall lead back to the control panel to a plated aluminum ground buss specific for grounding purposes and so labeled. The ground buss shall be complete with a lug large enough to accept the installing electrician's bare copper earth ground wire. The bus shall serve as a bond between the earth ground and the equipment ground wires.

B. Conduit

1. All wiring within the equipment enclosure and outside of the control panel or panels shall be run in conduit or metallic wire-ways, except for the watertight flexible conduit and fittings properly used to connect pump drivers, fan motors, solenoid valves, limit switches, etc., where flexible connections are best utilized.

2. Interior conduit shall be electrical metallic tubing (EMT), Sch 80 PVC, or metallic wire-ways.

3. Service entrance conduits shall be intermediate metal conduit (IMC) and shall be sized to accept the inbound service conductors in accordance with the National Electric Code. Conduit shall be provided from the utility power source to the pump station, through an opening in the skid and shall terminate at the pump station control center. Service conduit and wiring shall be provided by the installing contractor.

4. Conduit and metallic wire-ways shall be sized for the type, number and size of equipment conductors to be carried, in compliance with Article 358, Article 376 or Article 344 of the National Electrical Code as applicable and NEMA TC-2, Federal WC-1094A and UL-651 – Underwriter’s Laboratory Specifications.

5. Where flexible conduit is necessary, the conduit shall be liquid-tight, flexible, metal, corrosion resistant, non-conductive, UL listed flexible conduit. Flexible conduit shall be sized for the type, number and size of equipment conductors to be carried, in compliance with Article 350 of the National Electrical Code.

C. Wiring

1. Motor circuit wiring shall be sized for load. All branch circuit conductors which supply a single motor shall have an ampacity of not less than 125 percent of the motor full load current based upon NEC table 430.250. Wiring shall be dual rated type THHN/THWN, as set forth in Article 310 and 430 Part II of the National Electrical Code.

2. Control and accessory wiring shall be sized for load, type MTW/AWM (Machine Tool Wire/Appliance Wiring Material) as set forth in Article 310 and 670 of the National Electrical Code, except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.

D. Lighting

1. Interior Lighting

a. Light fixtures shall be LED type that is UL listed for wet locations.

b. The package pump station shall be supplied with one or more LED vapor tight interior lights. The lights shall include Thermal/Lumen balanced light engine, Non-Corrosive polycarbonate housing, stainless steel grade hasps and clips, back KO location and end sealed conduit openings, low power consumptions, ceiling or wall mounted options, IP66 rated with hermetic sealing and white finish. The light construction shall include a polycarbonate housing, clear lens with inside ribbing (translucent white lenses optional), electrostatic painted steel tray, and Class II driver. Wattage shall be 47 and driver lumens shall be 4197. Operating temperature range of -22F to 104F.

c. A UL listed, CSA certified light switch shall be located conveniently adjacent to the personnel entrance. It shall be mounted in a weatherproof enclosure.

2. Emergency Lighting

a. A 120 volt emergency lighting fixture shall be provided on the interior of the pumping station.

b. Emergency light fixtures shall be UL listed for damp location use.

c. Emergency light fixtures shall provide two adjustable heads that allow the operator to direct light where it will be most useful.

d. Emergency light fixtures shall have a maintenance free, sealed lead calcium, 6.0 volt, battery backup with a maximum full recharge time of twenty four hours and provide one and a half hour emergency operation.

e. Lamps shall be rated for 5.4 watts each.

f. Emergency light fixtures shall be provided with a test switch and LED charge /AC voltage indicator.

g. Emergency light fixture housings shall be made from impact resistant, injection molded thermoplastic.

3. Exterior Lighting

a. Exterior light fixtures shall be UL listed 120 volt, 70 watt, weather-proof HPS type and located at each door.

b. Exterior light fixtures shall be wired to a switch and equipped with a photo cell to allow for automatic dusk till dawn operation.

c. Exterior light fixture housings shall be one piece, injection molded, bronze polycarbonate.

E. Receptacles

1. Receptacles shall be duplex, ground fault circuit interrupter type receptacles with fault indicator light.

2. All receptacles shall be mounted in weather-proof enclosures.

3. All receptacles shall be UL and CSA listed and conform to NEMA WD-1 and WD-6.

F. Wall Mounted HVAC Unit

1. HVAC unit must be a one piece, factory assembled; pre-charged, prewired and tested air conditioning unit approved and listed by Underwriters Laboratories with built in heater.

2. The total cooling capacity of the unit shall be 42,000 BTUH and the sensible cooling capacity shall be 32,300 BTUH when handling 1000 CFM of indoor air at entering conditions of 80° F DB and 67° F WB and 95° DB outdoor ambient.

3. The unit shall be provided with a supplemental heater designed to provide 52,975 BTUH at 460 volts. The heater shall be a nominal 15 KW, 3 phase, 460 volts. Each heater is to be equipped with an automatic reset limit switch and a one time high temperature thermal cut out for additional safety back up protection.

4. Coils shall be of copper tube construction with mechanically bonded aluminum plate fins.

5. The compressor shall be a welded hermetic type with internal vibration isolators and built in thermal and over current protection devices.

6. The cabinet shall be a single, enclosed weatherproof casing constructed of 20 gauge galvanized steel. Each exterior casing panel to be bonded and finished with baked–on exterior polyester enamel paint prior to assembly.

7. The unit shall be designed so that it pulls air from the outside when ambient temperatures are cool enough to satisfy cooling requirements without running the compressor.

8. The HVAC unit shall be provided with a separate, exterior mounted disconnect switch mounted in a NEMA 3R enclosure adjacent to the HVAC unit.

G. Surge Protective Devices (SPD) – 480V 3-Phase

1. Integrated Type 2 SPD shall be listed in accordance with UL 1449 3rd Third Edition and UL 1283, 5th Edition, Electromagnetic Interference Filters, latest revisions.
2. Voltage Protection Rating shall be determined by a Measured Limiting Voltage Test using a 6kV/3kA combination wave surge resulting in a VPR of 1200V L-N, L-G, and N-G, and a VPR of 2000V L-L. SPD shall be tested with the ANSI/IEEE Category C high exposure waveform (20kV-1.2/50µs, 10kA-8/20µs).
3. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
4. The manufacturer of the SPD shall be Square D by Schneider Electric. Also, this distribution equipment shall be fully tested and certified to the following UL standards:
   a. UL 67 = Panelboards
   b. UL 845 = Motor Control Centers
   c. UL 857 = Bus way
   d. UL 891 = Switchboards
   e. UL 1558 = Low Voltage Switchgear
5. Minimum surge current rating shall be 240 kA per phase.
6. Nominal discharge current rating shall be 20kA.
7. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE Category C High transients without failure or degradation of clamping voltage by more than 10%.
8. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
9. SPD shall be constructed of one self-contained suppression module per phase.
10. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
11. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
12. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.

13. Terminals shall be provided for necessary power and ground connections.

14. SPD shall have a warranty for a period of ten (10) years from date of invoice. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

H. Variable Frequency Drives

1. AC Adjustable Speed Drive (ASD) used to control the speed/torque of a NEMA Design B induction motor.

a. The variable speed drive(s) shall be ABB ASC580 or pre-approved equal.

b. The Drive must provide a V/Hz, Sensorless Vector and Flux Vector mode of operation.

c. ACH drives manufactured for the HVAC industry are not acceptable.

d. The Drive manufacturing facility shall be ISO 9001:2000, ISO 14001: 2004 and OSHAS 18001: 1999 certified. The ASD shall be UL listed.

e. The Drive shall be subjected to a preliminary functional test, minimum one (1) hour burn-in and computerized final test. The burn-in shall be at 104°F (40°C), at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.

f. The Drive shall utilize efficient IGBT technology throughout the entire Drive manufacturer's Power and Voltage range. The Drive shall utilize the same communications architecture for high-speed connectivity throughout the entire Drive manufacturer's Power range.

g. The Drive shall be solid state, with a Pulse Width Modulated (PWM) output.

h. The Drive shall be a Sensorless Vector AC to AC converter utilizing the latest insulated gate bipolar transistor (IGBT) technology. The Drive shall employ a Sensorless Vector inner loop torque control strategy that mathematically determines motor torque and flux.

i. The Drive must also provide an optional operational mode for V/Hz or closed loop Flux Vector Operation.

j. The Drive shall be rated to operate from 3-phase power at 208VAC to 600VAC, +10% /-15%, 48Hz to 63Hz.

k. The Drive shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load.

l. The Drive efficiency shall be 98% or better at full speed and load.

m. An internally mounted AC line reactor or DC choke shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions. When a DC choke is utilized it shall be of swinging choke design to mitigate harmonics substantially more than conventional choke designs and shall provide equivalent to a

5% impedance. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.

n. Output voltage and current ratings shall match the adjustable frequency operating requirements of standard 200-575VAC, 3ph, 60Hz, NEMA Design B motors.

o. The short-term normal duty overload current capacity shall be 110% of rated current for one (1) minute out of ten (10) minutes. The short-term heavy-duty overload current capacity shall be 150% of rated current for one (1) minute out of ten (10) minutes and peak overload capacity shall be 180% for two (2) seconds out of each minute with an instantaneous overcurrent trip at 350% or higher.

p. Output frequency shall be adjustable between 0Hz and 500Hz.

q. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.

r. The Drive shall be furnished in a UL Type 1 (NEMA 1) listed enclosure rated for operation at ambient temperatures between -15° and 40°C at an altitude of 6500 feet, with relative humidity less than 95% and no condensation allowed.

1) The Drive shall be protected from atmospheric contamination by Chemical gasses and Solid particles per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.

2) The Drive shall be protected from vibration per IEC 60721-3-3, Class 3M4 (sinusoidal displacement 3.0 mm (0.12 in.), 2Hz to 9Hz; acceleration 10 m/s^2 (33 ft/s^2), 9Hz to 200Hz).

s. Start-up data entries shall include motor nameplate power, speed, voltage, frequency and current.

t. A motor parameter ID function shall automatically define the motor equivalent circuit used by the sensorless vector torque controller.

u. Two independent PID speed/torque loop regulators shall be provided with an autotune function as well as manual adjustments.

v. A dynamic braking chopper shall be provided on all models rated up to 15 horsepower 600V and up to 10 horsepower 240V.

w. A selection of eight (8) preprogrammed application macro parameter sets shall be provided to minimize the number of different parameters to be set during start-up. Macros included as standard are as follows:

1) ABB Standard,

2) 3-Wire,

3) Alternate,

4) Motor Potentiometer,

5) Hand/Auto,

6) PID Control,

7) Pump & Fan Control (PFC),

8) and Torque Control.

x. A selection of two (2) User Defined Parameter Sets shall also be available.

y. Carrier frequency shall be adjustable between 1 and 12 kHz up to 200 HP 480V or 150 HP 600V and between 1 and 4 kHz from 250 through 550 HP 480V.

z. The ASD shall automatically adjust the carrier frequency dependent upon Drive temperature and load. Increased temperatures result in automatically decreased switching frequency to ensure continuous operation of the Drive.

aa. Start/Stop control functions shall include:

1) Two (2) or three-(3) wire start/stop,

2) Coast/ramp stop selections,

3) Optional dynamic braking

4) Flux braking.

bb. The ASD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to reference without safety tripping or component damage (flying start).

cc. The ASD shall be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

dd. The ASD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

ee. Acceleration/Deceleration control functions shall include:

1) Two (2) sets for linear ramp time adjustments

2) Two (2) sets for s-curve ramp selections.

ff. Speed/Torque control functions shall include:

1) Adjustable min./max. speed and/or torque limits;

2) Selection of up to seven (7) preset speed settings or external speed control;

3) Two (2) independent built-in PID controllers to control a process variable such as pressure, flow or fluid level.

4) Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

gg. Output control functions shall include:

1) Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the

motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot;

2) A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits. The ASD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The Drive shall have user adjustable load curves (motor torque as a function of frequency) defined by five (5) points to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for Drive acceleration from zero speed without signaling a false underload condition. The Drive shall have programmable "Sleep" and "Wake up" functions to allow the Drive to be started and stopped from the level of a process feedback signal. Three (3) programmable critical frequency lockout ranges to prevent the ASD from operating the load continuously at an unstable speed.

hh. Open loop static speed regulation shall be 0.5 % to 1% of rated motor speed.

ii. When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.1% of motor nominal speed. Dynamic speed accuracy shall be less than 1%-sec with 100% torque step open loop and 0.5%-sec closed loop with 100% torque step.

jj. Torque control response time shall be less than 10 ms with nominal torque. In the torque regulating mode, torque regulating accuracy open loop shall be +/- 5%; torque regulating accuracy closed loop shall be +/- 2%.

2. Control Panel

a. Each ASD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel. The Display shall have contrast adjustment provisions to optimize viewing at any angle. The control panel shall provide a real time clock for time stamping events and fault conditions. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.

b. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable and insertable under Drive power, capable of remote mounting, and shall have its own non-volatile memory.

c. The standard operator panel shall provide a start-up, maintenance and diagnostic assistants that guides a new user through initial start-up and

commissioning of the Drive as well as provide indications for maintenance and help to diagnose a fault. In addition, a PID assistant, Real-time Clock assistant, Serial Communications assistant, and Drive Optimizer assistant shall be included. A Drive Optimizer assistant permits the user to choose Drive set-up for low nose, drive & motor efficiency or motor control accuracy. During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. At least twenty-six (26) selections shall be available including the following:

1) Speed/torque in percent (%), RPM or user-scaled units;

2) Output frequency, voltage, current and torque:

3) Output voltage, power and kilowatt hours;

4) Heatsink temperature and DC bus voltage;

5) Status of discrete inputs and outputs;

6) Values of analog input and output signals;

7) Values of PID controller reference, feedback and error signals;

8) Control interface inputs and outputs shall include:

   a) Six (6) digital inputs 12 to 24VDC PNP and NPN, all independently programmable with at least twenty-five (25) input function selections. Inputs shall be designed for “dry contact” inputs used with either an internal or external 24 VDC source;

   b) Three (3) form C relay contact digital outputs, all independently programmable with at least thirty (30) output function selections. Relay contacts shall be rated to switch a maximum two (2) Amps rms continuous current at a maximum switching voltage of 30VDC or 250VAC. Function selections shall include indications that the Drive is ready, running, reversed and at set speed/torque. General and specific warning and fault indications shall be available. Adjustable supervision limit indications shall be available to indicate programmed values of operating speed, speed reference, current, torque and PID feedback. An optional relay expansion card shall be available to provide three (3) additional relay outputs. This option card shall be integrally mounted;

   c) Two (2) analog inputs, each selectable for 0VAC - 10VAC or 4mA - 20mA, and independently programmable with at least ten (10) input function selections. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or

0-10V) is lost, the ASD shall give the user the option of the following:

(1) stopping and displaying a fault,

(2) running at a programmable preset speed,

(3) hold the ASD speed based on the last good reference received, or cause a warning to be issued, as selected by the user. The Drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus;

(4) Two (2) analog outputs providing 0 (4) to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least twelve (12) output function selections including output speed, frequency, voltage, current and power.

3. Serial communication interface modules

a. Communications modules shall be internally mountable.

b. I/O shall be accessible through the serial communications adapter.

c. The ASD shall have an RS-485 port as standard.

d. The standard embedded protocol shall be Modbus RTU.

e. Serial communication capabilities shall include, but not be limited to:

1) Run-stop control;

2) Speed set adjustment,

3) Proportional/integral/derivative PID control adjustments

4) Current limit,

5) Acceleration / deceleration time adjustments.

f. A minimum of fifteen (15) field parameters shall be capable of being monitored.

g. The Drive shall have the capability of monitoring feedback such as:

1) Process variable feedback,

2) Output speed/frequency,

3) Current (in amps),

4) % torque,

5) Power (kW),

6) Kilowatt hours (resettable),

7) Operating hours (resettable),

8) Relay outputs,

9) Diagnostic warning and fault information.

h. A remote Local Area Network (LAN) ASD fault reset shall be possible.

i. The DDC system shall be able to monitor if the motor is running in the ASD mode or bypass mode (if bypass is specified) over serial communications.

j. The ASD shall allow the DDC to control the Drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for Digital Ouput DO (relay) control and Analog Output (AO) control. This control shall be independent of any ASD function. Status of DO's and AO's are available over the communications link.

1) Examples of possible DO usage are as follows:

a) Opening check valves,

b) Opening discharge valves,

c) Starting auxiliary equipment, etc.

2) Examples of possible AO usage are as follows:

a) Controlling a bypass valve position

b) Throttling valve position, etc

k. Computer Interface

1) The operator panel port shall be connectable to a personal computer interface.

2) Microsoft© Windows based software shall be available for Drive setup, diagnostic analysis, maintenance, monitoring and control.

3) The software shall follow trends and provide real time graphical displays of Drive performance.

4) An additional user interface shall be offered as a palm sized portable, battery operated tool for fast, safe and easy parameter selecting, setting, downloading and uploading to a nonpowered drive.

5) Allow for "hiding" selected parameters to protect the application.

4. Protections

a. For each programmed warning and fault protection function, the Drive shall display a message in complete English words or Standard English abbreviations.

b. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and DI Status shall be stored in the Drive's fault history.

c. The last ten (10) fault names shall be stored in Drive memory.

d. The Drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.

e. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses.

f. Motor phase loss protection shall be provided.

g. The Drive shall provide electronic motor overload protection qualified per UL508C. Protection shall be provided for AC line or DC bus overvoltage at 130% of max. rated or undervoltage at 65% of min. rated and input phase loss.

h. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

i. Stall protection shall be programmable to provide a warning or stop the Drive after the motor has operated above a programmed torque level for a programmed time limit.

j. Underload protection shall be programmable to provide a warning or stop the Drive after the motor has operated below a selected underload curve for a programmed time limit.

k. Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.

Input terminals shall be provided for connecting a motor thermister (PTC type) to the Drive's protective monitoring circuitry and an input shall also be programmable to monitor an external relay or switch contact (klixon).

l. The drives shall include proper fusing to meet UL requirements.

5. Main Circuit Breaker

a. Main circuit breakers shall have an over-center, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.

b. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

c. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.

d. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle

accessories shall provide provisions for locking handle in the ON or OFF position.

e. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

f. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

6. Branch Circuit Breakers

a. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the associated drawings.

b. Molded case branch circuit breakers shall have bolt-on type bus connectors.

c. Circuit breakers shall have an over-center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.

d. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red indicator appearing in the clear window of the circuit breaker housing.

e. The exposed faceplates of all branch circuit breakers shall be flush with one another.

f. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Branch circuit breakers rated 30 amperes and below shall be UL Listed to accept 60° C rated wire.

g. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.

7. Utility Power Transformer

a. 15 kVA dry type distribution transformer to provide power for all single phase needs. The transformer shall be secured in a manner that assures the structural integrity of the vertical section and the transformer. Adequate ventilation for the transformer shall be provided.

b. Primary side circuit protection shall be provided.

2.7 PLC CONTROL PANEL

A. General

1. The PLC control panel shall be NEMA 12 rated.

2. The PLC control panel shall house the following equipment:

a. Human Machine Interface (HMI)

b. PLC with I/O as specified herein

c. Power supply

d. Surge suppressor

3. The PLC control panel shall be supplied, installed, wired, programmed and tested by the pump station manufacturer.

B. Products

1. PLC

a. The PLC shall be a chassis mount PLC designed for up to 1024 points of I/O.

b. The PLC shall:

1) Collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.

2) Be able to have its program downloaded from a remote workstation over a network, or locally programmed from a portable laptop computer.

3) Allow for the expansion of the system by addition and configuration of hardware.

4) Executive firmware shall be stored in Flash memory and can be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.

5) Each discrete point shall have a light emitting diode to indicate point status. Green shall indicate that the point is logic level “1”, also referred to as “on” or “high”.

6) The PLC shall utilize Ethernet protocols that meet the following:

a) Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).

b) Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)

7) Programming software will have embedded network configuration tools that utilize FDT/DTM technologies. PLC systems that have the PLC programming and network configuration tools in separate software will not be acceptable.

8) Each Processor shall have a USB terminal port for programming. The processor shall accept an 8Mb SD memory card. This card shall be capable of storing, at a minimum, application files, data files, PDF files, CAD files, Microsoft office files. Processor performance shall be rated at least 6,900 instructions per

millisecond at a program make up of 65% Boolean and 35% numerical.

9) The processor shall be equipped with 4,096 Kb of internal user RAM and have a multi-protocol serial port, and an Ethernet port.

10) Upon power loss, the PLC shall insure memory is transferred to flash memory before PLC RAM powers down. PLCs with a battery backup will not be accepted.

11) The PLC shall have on board status lights to indicate the following various functions:

    a) Green RUN lamp that will illuminate while the program is executing

    b) Red ERR lamp that will illuminate when a fault occurs in the processor

    c) Red I/O Lamp that will illuminate upon an I/O failure or configuration fault.

    d) Yellow SER COM lamp will illuminate when activity is present on the serial port

12) An eight (8) channel +/- 10V, 0-20mA, analog input card shall be provided.

13) A two (2) channel +/- 10V, 0-20mA analog output card shall be provided.

14) A sixteen (16) channel sink and source 24VDC discreet input card shall be provided.

15) A sixteen (16) channel 24VDC/240VAC relay output card shall be provided.

16) Communication Capabilities: The pump station PLC shall be equipped to communicate with separate SCADA PLC (provided by SCADA contractor, to be located within the pump station building) via Ethernet using Modbus TCP/IP protocol.

17) The PLC shall be an 8 slot chassis. The I/O cards will be secured to the chassis via a screw connection.

18) Programming cable: The PLC shall utilize a USB to Mini B cable for programming. This cable shall be compatible with those designed for downloading digital cameras to USB compatible PC. Accordingly, this cable shall be available through most traditional retail stores serving the consumer electronics market.

19) Alarming: The PLC shall have a configurable alarming capability. Each alarm point can be configured to display an alphanumeric message in the alarm buffer. The buffer can be displayed via a web page, or on an operator interface screen.

20) Unterminated connector cables shall have one end terminated to HE10 terminal block modules. The other end shall be unterminated to allow custom interface to panel devices.

21) Terminated connector cables shall have one end terminated to interface to terminal block, or FCN socket, cards. The other end shall be terminated to interface with HE10 terminal block modules.

22) All specified PLC platforms will be programmed using the same programming software package. PLCs that use multiple software programming packages under similar trade names will not be accepted.

23) The system shall be designed to execute all languages without a significant decrease in processing speed.

24) Programming software shall have integrated tools for network configuration, and communication capabilities. PLC's that use separate programming, communication, and network configuration software shall not be accepted.

25) The PLC must meet or exceed the following environmental requirements:

    a) Minimum temperature range:

        (1) Operating: -25 to +70o C (-13 to +158oF)

        (2) Relative humidity: 30% to 95% non-condensing.

    b) Altitude:

        (1) Operation 0-7,200 feet minimum

        (2) Storage 0-9,800 feet minimum

    c) Degree of protection: NEMA 1 (IP20)

    d) Vibration resistance in accordance with at least one of the following:

        (1) Installed rating:

            (a) DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and

            (b) Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.

        (2) In compliance with IEC 60068 and IEC 61131.

    e) Shock resistance: 147m/s2 for 11ms.

26) The PLC's shall be designed for connection to the World Wide Web via standard and customizable web pages. Standard web pages shall display all internal status points, status registers, alarm words, and status of each I/O point. Customizable web

pages shall be created by the programmer to display the actual process or machine being operated.

c. Manufacturer: The PLC an appurtenant component shall be manufactured by Schneider Electric, including the following model numbers (other models may be required in addition to those listed below, per manufacturer's design):

1) PLC: Modicon M340

2) Processor: BMXP342020

3) Input Module: BMXDDI1602

4) Relay Output Module: BMXDRA1605

5) Analog Input Module: BMXAMI0410

2. Human Machine Interface (HMI)

a. The HMI shall be a 10.4" color touch screen.

b. The HMI shall be TFT type providing 65,536 colors.

c. The HMI shall be equipped with built-in Ethernet TCP/IP functionality and equipped with one compact flash card slot and two USB ports.

d. The HMI shall be equipped to communicate over Ethernet via an onboard RJ45 port.

e. In addition to Ethernet communication, the HMI shall be equipped with one Sub-D9 and 1 RJ45 port for serial communication.

f. The HMI shall be a Schneider Electric Magelis Model No. XBTGT5330, or Engineer-approved equal.

2.8 INSTRUMENTATION

A. Pressure Gauges

1. System suction and discharge pressure gauges shall be panel mounted and located as shown on the drawings.

2. Pressure gauges shall be glycerin filled with a built-in pressure snubber.

3. Pressure gauges shall have a 4.5" face.

4. Pressure gauges shall be turret style. Case material shall be stainless steel with clear acrylic faces.

5. The gauge shall be bottom connected and accept a 1/4" NPT female thread. Combination pressure gauge range and scale graduations shall be in PSI and feet of water.

6. All gauges will be panel mounted off the pipeline and be connected to their respective sensing point via stainless steel or poly tubing. The gauge trim tubing shall be complete with both isolating and vent valves, and the tubing shall be so arranged as to easily vent air and facilitate gauge removal. Gauges mounted directly to the pipeline or at the sensing point will not be accepted.

B. Suction and Discharge Pressure Transmitters

1. The manufacturer shall provide two-wire, 4 to 20 mA dc analog output pressure transmitter.
2. WIKA S-20 type.
3. The pressure transmitter shall be provided with direct connect pressure seals.
4. Accuracy: ±0.20% of calibrated span.
5. Span Limits: From 1 to 6000 psi
6. Damping: Settable for a range of none to 8 seconds.
7. RFI Protection: The maximum error shall be no more than an additional ±0.1% of calibrated span for 30 V/m field intensity between 27 and 1000 MHz.
8. The electronics housing shall be NEMA 4X rated and constructed of 316 stainless steel or aluminum with an epoxy finish. It shall consist of two compartments for field wiring and electronics. The housing shall be sealed with O-rings for double protection against moisture or other contaminants.
9. Electronics shall be easily field replaceable.
10. The pressure transmitter shall have an LCD Indicator with on-board pushbuttons for calibration and configuration.
11. The pressure transmitter shall be connected direct to process piping or pressure seal with 1/2 NPT external threads to process piping. Internal 1/4 NPT thread also provided as plumbing connection to process; or prepared for a direct connect seal or capillary connected seal.
12. Sensor material shall be 316 S.S.

C. Flow Meter and Flow Transmitter

1. Flow meter manufacturer: a Elster evoQ4
2. Flow meter shall be of the electromagnetic type, pulse transmitter, and provided with two grounding rings
3. Stainless steel electrodes
4. Flow meter shall be provided with an EPDM lining designed specifically for potable water applications and shall be NSF 61 compliant.
5. Accuracy: +/- 1.5% of true flow value through normal flow range.
6. Flow meter shall be designed for the maximum operating pressure of the pumping station with a 1.5 safety factor.
7. Minimum pressure rating: 250 psi.
8. Replacement Steel Spool - Contractor to provide flanged steel spool the same dimensions as flowmeter as a spare part.

2.9 CORROSION PROTECTION

A. Provide surface preparation and coatings for all ferrous pipe, fittings, flanges and valves as indicated in this Section.

B. All exposed steel surfaces not otherwise specified in this Section shall be treated as follows:

1. All surfaces of the exposed steel structure not in direct contact with process water, interior and exterior, shall be grit blasted equal to commercial base cleaning (SSPC-SP6).

2. After all welding has been completed, all steel surfaces of the structure shall be factory blasted to remove all rust, mill scales and weld slag. All weld spatter and surface roughness shall be removed by grinding. Surface preparation will comply with SSPC-SP10 specifications. The blast profile on the steel should be 1.5 to 2.5 mils in depth and be of a sharp, jagged nature. Surfaces must be free of grit dust.

3. All interior surfaces of the exposed steel structure in direct contact with process water shall be grit blasted equal to commercial base cleaning (SSPC-SP10).

4. The protective coating shall take place immediately after surface preparation.

5. Following the cleaning, all weld areas shall coated by hand brushing using Tnemec 66 or Devoe High Performance Coatings Bar-Rust 235 multi-purpose epoxy coating. Following the hand coating, the balance of the structure shall be coated per the attached specification.

6. The structure and other exposed metal shall receive a 4-8 mils dry or 5.9 to 11.7 mils wet coating of Devoe High Performance Coatings Bar-Rust 235 multi-purpose epoxy coating. The high solids coating shall be an advance technology epoxy and have exceptional corrosion protection. The coating shall be suitable for salt and freshwater immersion. Solids by volume shall be 68% +/- 2%.

7. A touch-up kit containing epoxy coatings, as specified above, shall be provided for the coating of all field welds and for repair of any scratches or abrasions that have occurred during shipment or installation.

C. All stainless steel and non-ferrous metal components shall be electrically isolated from steel and iron pipe, valves and fittings using suitable dissimilar metal isolation kits constructed of dielectric materials with a minimum dielectric strength of 500 volts/mil.

PART 3 EXECUTION

3.1 FACTORY PUMP PERFORMANCE TESTING

A. A certified performance test shall be performed on each pump and rotating assemblies utilizing its specified electric motor.

B. All tests shall be performed in accordance with the Hydraulic Institute Test Standards for Centrifugal Pumps - 1.6 (1988).

C. Run pump at full speed rating point for 60 minutes prior to start of any testing.

D. Six evenly spaced test points shall be taken and shall include conditions at shut-off (zero flow) and the operating points specified herein.

1. Where specified operating points require reduced pump speed, separate six-point curves at each required speed shall be provided. Use factory calibrated test drives for reduced speed tests.

E. Each performance test point, measure flow rate, differential pressure, RPM, horsepower and efficiency.

F. Operate pump for not less than 60 minutes and take reading to determine the pump will run as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the appropriate submergence as required.

G. Testing Tolerances:

1. ANSI/HI 1.6 Acceptance Level A
2. Tolerance: Pump test results shall be judged at rated rate of flow and RPM with applicable total head and efficiency as defined by ANSI/HI 1.6 for the pump conditions specified and indicated.
3. If pumps do not meet the tolerances specified, trim or replace the impeller and retest until the specified results are obtained.
4. Acceptance shall be conditional upon meeting the minimum efficiencies at each operating condition specified herein.

3.2 MOTOR TESTING

A. All electric motors shall comply with ANSI/NEMA MG-1 and MG-2. .

B. Certified tests shall be performed as required by NEMA MG-1. Each motor shall be subjected to a complete engineering test including the following:

1. No load running current
2. Locked motor current
3. High potential test
4. Winding resistance
5. No load vibration check
6. Temperature rise
7. Full load current and speed
8. Starting current and torque
9. Breakdown torque
10. Efficiency and power factor at 100%, 75% and 50% of full load
11. Peak to peak amplitude of vibration under no load
12. Speed torque curve

C. Efficiency tests shall be conducted in accordance with IEEE 112 Method B.

3.3 HYDROSTATIC TESTING

A. When the station plumbing is completed, the pressure piping within the station (including valves, pumps, control valves, and fittings) connections make up, the entire system shall be hydro-statically tested at a pressure not less than 150% of max system design pressure.

B. The test pressure shall be applied for a minimum of 60 minutes, during which time all joints, connections, and seams shall be checked for leaking.

C. Any deficiencies found shall be repaired and the system shall be re-tested at no expense to the Owner.

D. All factory-installed plumbing shall be hydrostatic tested in the factory by the pump station supplier. All field-installed plumbing, including connection piping to the pump station, shall be hydrostatic tested in the field by the Contractor prior to pouring the concrete floor.

3.4 ELECTRICAL SEQUENCE TESTING

A. Prior to shipment, the electrical system and controls shall be tested at the manufacturer's facility to insure the specified sequence of operation is met.

B. Copies of the test report shall be provided as a part of the systems operation and maintenance manual.

3.5 INSTALLATION

A. Contractor shall coordinate with pump station manufacturer and make measurements of actual pump station dimensions and pipe connection locations and elevations prior to constructing foundation or installing yard pipe risers. Contractor is wholly responsible to align foundations, piping and any other connections with pre-fabricated pump station in the field.

B. Unloading of the package should be done using a spreader bar to insure the lifting cables/slings do not damage piping, control panels, etc. Spreader bar to be six feet longer than the width of the enclosure.

C. The pump system should be set on a concrete foundation as specified and shown in the Drawings.

D. Level the skid using metal wedges or shims if necessary, and as required.

E. Make system connections. If through-the-floor connections are specified, the final turn-up cut shall not be made until the system is set in place.

F. Position the floor drains and pipe with the outlets as indicated on the contract drawings.

G. After making the piping connections, backfill as required.

H. Electrical connections should be completed to the pump station control center (as required).

I. Verify alignment of shafts and other equipment prior to operation, both before and after grouting. Ensure all alignments are within manufacturer's recommended tolerances and field align as needed.

J. After building is in place with doors and door closers aligned and adjusted, set gate stops for door cane bolts in wet concrete of porches and driveway, so that plate is flush with finished surface and channel is perpendicular to door's swinging path when fully open. Before the concrete sets, verify that angle and position of gate stop will allow bolt to fully engage the gate stop at the center of the gate stop. The building will require shims under the base to ensure the doors work properly.

K. Lightning Protection

1. The installation of lightning protection shall be accomplished by the installing electrician, working under the direct supervision of the manufacturer and

Contractor. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splicers, and bonds with cable downleads routed concealed either directly in the building construction or in 1" PVC conduit to ground. Downlead cables shall not be brought directly through the roof. Through-roof connectors with solid rods or conduit through approved flashings shall be utilized for this purpose. Copper equipment shall not be connected to aluminum surfaces except by means of an approved bimetal transition fittings.

2. Shop drawings and plans for the system installation shall be approved by the Engineer before the cutting, fabricating, assembling, finishing, delivering or installation of any materials specified herein.

3. The installer will work with other trades to insure a correct, neat, and unobtrusive installation. The lightning protection installer shall assure a sound bond to the main water service and interconnection with other building ground systems, including both telephone and electrical. All final flashing and sealing of lightning protection system roof penetrations shall be furnished and installed by the building manufacturer.

4. The installation shall comply with the applicable codes. All materials shall be new. Defective equipment and equipment damaged in the course of installation or tests shall be replaced or repaired in a manner meeting the approval of the engineer.

5. The lightning protection system extension shall receive the Underwriters Laboratories Master Label. The master label shall be evidence that the installation of the lightning protection system has been made by an installer accredited by a manufacturer of listed lightning protection materials, that materials used are subject to factory inspection and are labeled and that the installation will require a field inspection program by UL with a report of inspection to the Owner, covering proper installation of the labeled materials according to UL requirements. Coordinate all facets of the extension to maintain master label for existing system and to provide a complete master labeled system for the entire complex. The contractor shall also submit copies of as-built shop drawings with LPI Form LPI-1-R91 to finalize the LPI Certified System Application with a copy of the test results. Products shall comply with UL 96A and NFPA Standard #78.

6. AIR TERMINAL RODS: Shall be securely connected to and made electrically continuous with the roof conductors. Air terminals shall extend above the roof to which they are attached. Where practicable all air terminals shall be provided with at least two paths to ground.

7. Air terminal rods shall be 24 inches in height and shall have a tapered point. The rod shall be 1/2 inch minimum diameter below the point and shall be solid copper.

8. Roof Conductors shall be connected to all metal parts of the roof. Sharp turns in conductors shall be avoided. Bends shall have a radius of eight inches or more and shall not turn more than 90 degrees. Roof conductors shall be connected to form a closed loop and connect all air terminals together. Connections to air terminals shall be made with screwed or bolted clamps.

9. Down Conductors shall be electrically continuous from all terminals or roof conductors to the grounding system. Down conductors shall be concealed and shall be as widely separated as possible. All connections to down conductors shall be made with screwed or bolted clamps.

10. After the installation of the lightning protection and static grounding system is completed and at such time as the Engineer may direct, the Contractor shall provide a UL field inspector to conduct an operating test, as specified by the manufacturer, for approval. The Contractor shall furnish all instruments and personnel required for the test and it shall be performed in the presence of the Engineer and Owner. Loose connections, inadequate ground or improper workmanship found by such tests shall be replaced or corrected at the Contractor's expense and the system retested until conditions are satisfactory. A report on the test shall be provided to the Owner.

11. Connections shall be made in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors hardware, conductors and connections methods so metal in direct contact will be galvanically compatible.

12. All clamps used in connecting conductors to each other and to air terminals shall be made of high conductivity copper or bronze alloy suitable for copper-copper or copper-bronze joints as the cast may be, and drawn tight with bolts or capscrews of similar metal clamps. Bolts or capscrews shall be of sufficient cross section that there shall be no distortion or breaking under any stress to which they might be subjected under ordinary usage.

13. Counterpoise conductor below grade shall be bare stranded copper lightning protection and grounding conductor weighing not less than 420 pounds per thousand feet. The size of any wire in the cable shall be not less than .0689". Roof conductors shall be bare stranded copper lightning protection conductor weighing not less than 320 pounds per thousand feet, 24 strand, 14 gauge. Down lead conductors shall be bare stranded copper lightning protection conductor weighing not less than 320 pounds per thousand feet, 24 strand, 14 gauge.

14. Ground rods shall be one inch round and ten feet long, copper weld with top of the rod three feet minimum below grade.

L. Contractor or their subcontractor shall install:

1. Gutters & downspouts

2. Lightning Protection System

3. HVAC shield

4. Fire extinguishers, rated for electrical fires in accordance with building size. At least one fire extinguisher shall be mounted to the interior wall near each door. This should be provided by Dakota Pump.

3.6 START-UP SERVICES

A. The manufacturer will provide the following start up services for each pump station.

B. At startup, verify air is bled out of each pump.

C. The manufacturer of the pump station shall provide a representative to supervise the unloading and reassembly of the pump station at the job site by the Contractor. All

electrical connections within the pump station shall be completed by the station manufacturer except connection to the power utility provider.

D. The manufacturer of the pump station shall provide a start-up service technician for up to five (5) eight-hour days (or additional time, if dictated by conditions in the field) for the purpose of start-up supervision and operator training.

E. The manufacturer of the pump station shall provide a control system integrator for up to five (5) eight-hour days (or additional time, if dictated by conditions in the field) on a separate site visit for the purpose of coordination of controls and SCADA.

F. The Contractor shall provide necessary personnel during start-up and training to facilitate this work and to address any problems or defects which may arise during this work.

G. The pump station manufacturer's start-up service technician shall prepare a service report following start-up and distributed as follows:

1. Manufacturer's File
2. Engineer's File
3. Contractor's File
4. Owner's File

3.7 SPARE PARTS (PROVIDED BY PUMP STATION SUPPLIER)

A. Contractor shall supply the following spare parts to NTUA, left at each pump station:

1. One (1) set of mechanical seals, as specified
2. One (1) single-body air valve assembly

END OF SECTION

SECTION 26 01 00

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

1.2 ELECTRICAL DIVISION INDEX

26 01 00	General Electrical Provisions
26 05 23	Control Voltage Electrical Wire & Cables
26 11 00	Raceways
26 12 00	Wires and Cables
26 12 16	Transformers
26 13 00	Outlet Boxes
26 13 30	Cabinets
26 14 00	Wiring Devices
26 15 00	Motors
26 15 50	Motor Starters
26 16 00	Panelboards
26 17 00	Motor and Circuit Disconnects
26 18 10	Fuses
26 19 00	Relays and Contactors
26 27 33	Instrumentation and Controls Requirements
26 45 00	Grounding
26 56 00	Exterior Lighting
26 60 10	Lightning Protection
27 43 30	SCADA Radio Telemetry System

1.3 REQUIREMENTS

A. Furnish all labor, materials, service, equipment and appliances required to complete the installation of the complete Electrical System in accordance with the Specifications and Contract Drawings.

1.4 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

A. Regulatory Agencies: Installation, materials, equipment and workmanship shall conform to the applicable provisions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC) and the terms and conditions of the Electrical Utility and other

authorities having lawful jurisdiction pertaining to the work required. All modifications required by these codes, rules, regulations and authorities shall be made by the Contractor without additional charge.

B. Underwriters Laboratories (UL) or Factory Mutual (FM): All materials, appliances, equipment or devices shall conform to the applicable standards of Underwriters Laboratories, Inc. or Factory Mutual, Inc. The label of, or listing by, UL or FM is required.

C. Standards: Where referenced in these Specifications or on the Drawings, the publications and standards of the following organizations shall apply: Joint Commission on Accreditation of Healthcare Organizations (JCAHO), American Society of Testing and Materials (ASTM), Insulated Power Cable Engineers Association (IPCEA), National Fire Protection Association (NFPA), American National Standards Institute (ANSI), and National Electrical Manufacturers Association (NEMA).

D. Conflicting code requirements shall be brought to the attention of the Engineer. Where two or more codes apply, the most stringent of the codes shall govern.

1.5 SUBMITTALS AND SUBSTITUTIONS

A. Material List: Within 30 days of Contract Award or Notice to Proceed and before material is ordered, the Contractor shall submit for approval a list of all proposed material and equipment, indicating manufacturer's name and general description.

B. Shop Drawings: Submit for approval to the Engineer a minimum of six copies of all shop drawings no later than 30 days after the material list has been approved and prior to ordering any material. Show complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of special nature or critical to the installation and pertinent data required for installation. Indicate in the transmittal that submittal has been reviewed and accepted and all Contract deviations identified. In addition to specific references or requests; submit shop drawings for the following applicable items: panelboards, lighting fixtures, transformers, primary cable and gear, alarm systems and all special equipment.

C. Substitutions may be requested in accordance with the specification.

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS: The Electrical requirements for equipment specified or indicated on the Drawings are based on information available at the time of design. If equipment furnished for installation has Electrical requirements other than indicated on the Electrical Drawings, the Contractor shall make all adjustments to wire and conduit size, controls, overcurrent protection, grounding, and installation as required to accommodate the equipment supplied, without additional charge to the Owner. All adjustments to the Drawings reflecting the Electrical System shall be delineated in a submittal to the Engineer immediately upon knowledge of the required adjustments. The complete responsibility and costs for such adjustments shall be assigned to the respective section of these Specifications in which the equipment is furnished.

2.2 MATERIALS

A. All similar materials and equipment shall be the product of the same manufacturer.

B. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the Contract requirements and meets the approval of the Engineer.

C. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.

2.3 ALTITUDE: Equipment affected by altitude shall perform satisfactorily the function intended at the altitude of the project site.

2.4 WET AREA EQUIPMENT: All equipment within the buildings shall be installed in a NEMA 3R, NEMA 12 or weatherproof enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), unless otherwise noted on the drawings.

PART 3 EXECUTION

3.1 GENERAL: Fabrication, erection and installation of the complete Electrical System shall be done in a first class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Contractor shall check all areas and surface where Electrical equipment or material is to be installed, removed or relocated and report any unsatisfactory conditions to the Engineer before starting work. Commencement of work signifies this Contractor's acceptance of the prevailing conditions.

3.2 TEMPORARY POWER AND LIGHTING: Furnish and install all temporary Electrical facilities required for construction and safety operation. No part of the permanent Electrical Systems or the existing Electrical System may be used for temporary service unless approved by the Engineer.

3.3 UTILITIES

A. GENERAL: The Drawings reflect requirements of the serving utilities based on information derived from representatives of the utilities. During the project design phase, the fact that the Engineer may undertake to show the utility(s) requirements, does not necessarily indicate that the Engineer represents the utilities or their requirements; therefore, within 10 working days after Contract Award and/or Notice to Proceed has been issued, the Contractor shall be responsible for coordinating the requirements of the utilities for the Power System. The Contractor shall be responsible for coordinating the requirements for the Telephone, and Fiber Optic, if applicable.

B. Any deviations from the documents shall be brought to the attention of the Engineer no later than 10 working days after Award of Contract and/or Notice to Proceed. Failure to notify the Engineer within the 10-day time frame signifies the acceptance of documents and utility requirements by the Contractor and all associated costs therein.

3.4 EXCAVATION: Comply with Division 31 “Earthwork”.

3.5 PERFORMANCE TESTS

A. Thoroughly test all fixtures, services and all circuits for proper operating conditions and freedom from grounds, surges, and short circuits before acceptance is requested. All equipment appliances and devices shall be operated under load conditions.

B. After the interior-wiring system installation is complete and at such time as the Engineer may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices and equipment after installation to assure that all material continues to possess all the original characteristics as required by the governing codes and standards as listed in these Specifications.

C. After occupancy of the building has taken place and nominal building power loads have been established, make voltage readings at all panelboards. Based on these readings make final adjustments of taps on all transformers in the building, as directed by the Engineer. Submit to Engineer correspondence and/or drawing delineating readings.

D. Perform such other tests as required by other sections of these Specifications or as requested by the Engineer to prove acceptability.

E. Furnish all instruments and labor for testing.

F. The contractor will provide personnel to configure and startup all VFD's, Radio Transmitter Units (RTU'S) (including video signal or microwave transmission, if required), PLC control panels, starters and any other control or monitoring equipment not listed that was provided and installed by the Electrical Contractor at no additional cost to the owner.

3.6 OPERATING INSTRUCTIONS AND MANUALS

A. Instructions: Without additional charge to the Owner, the Contractor shall provide an experienced and competent representative to instruct the Owner or his representative fully in the concept, theory, operations, adjustment and maintenance of all equipment furnished for the Electrical System. Contractor shall provide at least two (2) weeks notice to the Engineer in advance of this period. Contractor shall provide DVD of instructions to Owner not less than two (2) weeks prior to scheduled final acceptance of the Project.

B. Manuals: Upon completion of the work, prepare and deliver to the Owner three (3) sets of complete operating and maintenance manuals for the systems and major equipment installed. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists and manufacturer's operating and maintenance data. Operating and maintenance manuals as required herein shall be submitted to the Engineer for review and distribution to the Owner not less than two (2) weeks prior to the scheduled final acceptance of the Project.

C. Other: The above requirements are in addition to specific instruction and manuals specified for individual systems or equipment.

3.7 DRAWINGS

A. General: The Electrical Drawings show the general arrangement of all conduit, equipment, etc. and shall be followed as closely as actual building construction and the work of other trades will permit. The Architectural and Structural Drawings shall be considered as a part of the work insofar as these Drawings furnish the Contractor with information relating to the design and construction of the building. Architectural Drawings shall take precedence over Electrical Drawings. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, elbows, pullboxes and accessories as may be required to meet such conditions.

B. Field Measurements: The Contractor shall verify the dimensions governing the Electrical work at the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions and those indicated on the Drawings.

3.8 LOCATION OF EQUIPMENT AND OUTLETS

A. The approximate locations of cabinets, panelboards, wiring gutters, switches, lights, light outlets, power outlets, etc., are indicated on the Drawings; however, the exact location shall be determined after thoroughly examining the general building plans and by actual measurements during construction to avoid conflicts with any Structural, Architectural, or other trades, with all locations subject to the approval of the Engineer.

B. Verify with the Engineer all locations of conduit, boxes, etc., stubbed in the floor prior to installation.

3.9 IDENTIFICATION AND SIGNS

A. Mark each individual motor controller, disconnect switch, transformer and remote control device to identify each item with its respective service using engraved nameplates.

B. Provide nameplates with engraved lettering not less than 3/8" high where specified or noted. In general, use white core laminated plastic, attached with screws. Embossed plastic adhesive tape is not acceptable. Flush mounted devices may have identification engraved in the device plate.

C. Identify panelboards, transformers and cabinets by engraved nameplates with descriptions indicated on the Drawings together with indication of the location of the feeder overcurrent protection. Install on inside of hinged doors or panelboards and cabinets.

Example: Panel 2P

120/208V, 3-phase, 4-wire

Fed from Panel MDP/cct. #4

D. Provide warning signs on all equipment or devices operating at 300 volts or more, reading "DANGER-480 VOLTS", etc. with white letters on red background of standard code size. Signs shall be decals.

E. All underground utilities indicated on the Drawings shall have a 6" wide plastic marker installed continuously in the trench at 12" below grade. The marker shall have continuous markings embossed in the tape identifying the system installed, i.e., communications, fiber optic, telephone, power.

F. Identify all exposed conduits, junction and pullboxes at maximum intervals of twenty feet and as indicated below. Identify exposed conduits according to the system carried by means of appropriate UL-recognized Brady wire marking sleeves, conduit and voltage markers, or approved equal by the Owner. Identify junction and pullboxes by painted on stencils or approved labels. Identification shall be placed at necessary intervals on straight conduit runs, close to all terminations, adjacent to all changes in directions and where conduits pass through walls or floors. Permanent identification markings on the sleeve or marker shall be to specification. Primary labels shall include voltage and shall have black lettering on an orange background. Secondary labels shall include information regarding power distribution such as “Fire Alarm” or “Grounding” and shall have a color scheme as indicated below. If the conduit is less than ¾” in diameter, color banding plus tags may be used. Color banding shall be ½” wide and resist UV rays, abrasion, corrosion, alkali, and acids.

1. Electrical Conduit Color Code (Common Ground Alliance Best Practices and APWA Uniform Color Code)

Secondary Label and Banding Color	Conduit Contents
Red	Fire Alarm Systems
White	Access/Security Systems
Dark Blue/White	Data Systems
Gray	Telecommunications
Black	120/208 Volt Power
Orange	277/480 Volt Power
Green	Grounding
Black/White	Computer/Data
Red (White on Red)	Electric Power Lines, Cables, Conduit, and Lighting
Orange (Black on Orange)	Communication, Alarm
White on Red	Fire Alarm System
White on Brown	Can be used for clarity on a Conduit not mentioned

F. Identify all receptacles and switch devices with the circuit and overcurrent protection device. Identification may be by waterproof, permanent marker on the rear of the device cover plate or as approved by the Engineer and Owner.

3.10 WARRANTY: Deliver originals of all guarantees and warranties on this portion of the work to the Engineer. Warrant all equipment, materials and workmanship for one year in accordance with the terms of the Contract.

3.11 PRODUCT HANDLING: Use all means necessary to protect Electrical materials and equipment before, during and after installation and to protect the installed work of other trades.

3.12 RECORD DRAWINGS: As part of this Contract, the Contractor shall provide a complete marked-up set of Contract Documents indicating all changes to the documents during the project construction phase to the Engineer. Changes to the Electrical System shall be documented on a set of "Record Drawings" on a daily basis.

END OF SECTION

SECTION 26 05 23

CONTROL-VOLTAGE ELECTRICAL WIRE AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. RS-232 cabling.
2. RS-485 cabling.
3. Low-voltage control cabling.
4. Control-circuit conductors.
5. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Source quality-control reports.

C. Field quality-control reports.

D. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.

4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1581.

2.2 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.3 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Shielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Control Circuits: Stranded copper, Type THHN-THWN, in raceway.

2.5 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Cable will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Cables may not be spliced. Secure and support cables at intervals not exceeding 6 inches from terminals.

2. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.

3. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination points. Remove and discard cable if damaged during installation and replace it with new cable.

4. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

5. Pulling Cable: Monitor cable pull tensions.

C. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

D. Separation from EMI Sources:

1. Separation between cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

2. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

3. Separation between cables in grounded metallic raceways and power lines and electrical

equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

4 Separation between Cables and Electrical Motors and Transformers, 5 kVA or 3HP and Larger: A minimum of 48 inches.

5 Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.2 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

- Class 1 remote-control and signal circuits, No 14 AWG.
- Class 2 low-energy, remote-control, and signal circuits, No. 18 AWG.

3.3 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding."

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 26 Section "General Electrical Provisions"

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance.

2. Visually inspect cable placement, cable termination, grounding and bonding, and labeling of all components.

3. Test cabling for resistance, shorts, opens, intermittent faults, and polarity between conductors.

C. Document data for each measurement and submit.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 11 00

RACEWAYS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 CONDUITS

A. Rigid Steel Conduit: Rigid, threaded, thick-wall with zinc-coated on the inside and either zinc-coated or coated with an approved corrosion-resistant coating on the outside. Conduit installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

B. Rigid Aluminum Conduit: Rigid, threaded, thick-wall type, approved for the application.

C. Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated or coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.

D. Rigid Non-Metallic Conduit: Schedule 40, high impact PVC with 7,000 psi tensile strength at 73.4 degrees Fahrenheit, 11,000 psi flexural strength, 8,600 psi compression strength, approved 90 degree conductors. Carlon, Triangle or approved equal.

E. Electrical Metallic Tubing (EMT): Mild steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion-resistant coating on the inside.

F. Flexible Conduit: Commercial Greenfield, galvanized steel, with a separate grounding bond wire installed in the conduit in addition to other wires.

G. Liquid-Tight Flexible Conduit: Flexible galvanized steel tubing with extruded liquid-tight PVC outer jacket and a separate grounding conductor installed in the conduit.

H. Conduit Size: Minimum conduit size 1/2" except where specifically approved for equipment connections. Sizes not noted on the Drawings shall be as required by the NEC.

2.2 CONDUIT FITTINGS

A. Rigid Steel Conduit, IMC and EMT Fittings: Iron, steel, die-cast only. Conduit fitting and bodies installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

B. Rigid Aluminum Conduit Fittings: Malleable iron, steel or aluminum alloy. Ferrous fittings zinc-coated or cadmium plated. Aluminum alloy fittings shall conform to the characteristics defined by UL for rigid aluminum metallic conduit and shall not contain more than 0.04 percent copper.

C. Rigid Non-metallic Conduit Fittings: Approved for the purpose and as recommended by the manufacturer.

D. Flexible Conduit Fittings (Commercial Greenfield): Either die-cast, steel, or malleable iron only with insulated throats and shall be of one of the following types:

1. Squeeze or clamp type with bearing surface contoured to wrap around the conduit and clamped by one or more screws.

2. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

3. Wedge and screw type with angular in-edge fitting between the convolutions of the conduit.

E. Liquid-tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon, or equal plastic compression ring and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without "O" ring seal.

F. Connectors and Couplings: Compression type threadless fittings for rigid steel conduit or IMC not permitted. Set-screw type fittings for rigid aluminum conduit not permitted. EMT couplings and connectors either die-cast, steel, or malleable iron only, "Concrete-tight" or "Raintight", and either the gland and ring compression type or the stainless steel multiple point locking type. Connectors to have insulated throats. EMT fittings using set-screws or indentations as a means of attachment are not permitted.

G. Bushings: Insulated type, designed to prevent abrasion of the wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC, and rigid aluminum conduit.

H. Expansion Fittings: Each conduit that is buried in or rigidly secured to the building construction on opposite sides of a building expansion joint and each run of 100 feet of exposed conduit shall be provided with an expansion fitting. Expansion fittings shall be hot dipped galvanized malleable iron with factory-installed packing and a grounding ring.

I. Sealing Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits and threaded cast aluminum type for aluminum conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2.3 WIREWAYS: Square D Company square duct lay in type without knockouts with lengths and fittings hinged to provide an unobstructed wireway to "lay-in" conductors, use standard lengths. Field cuts permitted where absolutely necessary. Rust-inhibiting phosphatizing coating on sheet metal parts. Blue-gray baked enamel finish. Hardware plated to prevent cross fittings, transposition section, gussett brackets, nipples, pull boxes, reducer fittings, wall flanges, panels or cabinet flanges, elbows, ceiling and wall support brackets and supporting hardware, etc.

PART 3 EXECUTION

3.1 CONDUIT INSTALLATION

A. Conduit Systems: Rigid steel conduit, IMC, rigid non-metallic conduit or EMT unless otherwise specified. Rigid Steel conduit shall be installed in the Chlorination building control

room and Rigid Steel conduit that's PVC coated on the inside and outside shall be installed in the Chlorination building Chemical room. Refer to drawings for additional requirements.

B. Aluminum Conduit: Aluminum conduit may be used only in dry locations above ground in sizes two inch or larger for Power and Communications Systems.

C. Rigid Non-metallic Conduit: Install in accordance with manufacturer's recommendations. Joints shall be solvent welded. Field bends shall utilize approved bending equipment. Provide rigid steel elbows and rigid steel conduit risers on underground runs or runs in concrete. Provide a suitable bond wire in each run except low voltage communications runs. Underground runs under concrete slabs may be direct buried without concrete encasement if of approved type. Rigid non-metallic conduit may be used for the secondary service conduit between the transformer and main distribution panel outside the perimeter of the building only when encased in concrete. Concrete total encasement shall be a minimum of four inches around outside of conduit. Rigid non-metallic conduit is not permitted to be surface mounted in ducts, plenums or other air handling spaces. All 90 degree bends installed in underground runs shall be rigid steel conduit. For encased conduits carrying 600 volts or more, the concrete shall be colored red using a permanent dye

D. EMT: Not permitted underground or embedded in concrete.

E. Flexible Conduits: Use flexible conduit only for motor or equipment connections and then only to the extent of minimum lengths required for connections. Length shall not exceed 5 feet without approval from the Engineer and Owner. Install flexible conduit connections at all resilient-mounted equipment. Provide liquid-tight flexible conduit in exterior, wet or damp locations and for connections to wet pipe mechanical systems.

F. Conduit in Concrete: Rigid steel conduit or rigid non-metallic conduit may not be embedded in concrete that is in direct contact with the earth. When embedded, the outside diameter shall not exceed one-third the thickness of the concrete slab, wall or beam, shall be located entirely within the center third of the member, and the lateral spacing of conduits shall not be less than three diameter unless otherwise prohibited by Engineer.

G. Steel Conduit in Ground: Rigid steel conduit that is not completely encased in concrete but is in contact with ground or on a vapor barrier shall be wrapped with Scotchwrap 51 half-lapped, or shall have an additional outside factory coating of polyvinyl chloride with a minimum coat thickness of 20 mils. Other PVC or Phenolic-resin epoxy coating material which is equally flexible and chemically resistant may be used providing approval by the Engineer is obtained prior to the installation.

H. Exposed Conduits: Install exposed conduit systems parallel to or at right angles to the lines of the building. Right angle bends in exposed runs shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii not less than those of standard elbows.

I. Concealed Conduits: Install conduit systems concealed unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities, and where specifically approved by the Engineer. Install concealed conduit systems in as direct lines as possible.

J. Conduit Openings: Protect all vertical runs of conduits or EMT terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.

K. Sealing Fittings: Install where required by the NEC, where conduits pass from warm to cold locations and where otherwise indicated.

L. Sleeves for Conduit: Install sleeves for conduit where shown or as required. Conduit sleeves not used shall be plugged with recessed type plugs. Sleeve all conduit passing through walls. Sleeves that are used shall be sealed tight with rated fire and smokeproofing compounds.

M. Duct seal all conduit ends.

3.2 CONDUIT SUPPORTS

A. Supports: Provide supports for horizontal steel conduits and EMT not more than eight feet apart with one support near each elbow or bend and one support within one foot of each coupling, including runs above suspended ceilings.

B. Straps: Install one-hole pipe straps on conduits 1-1/2" or smaller. Install individual pipe hangers for conduits larger than 1-1/2". Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.

C. Trapezes: Install multiple (trapeze) pipe hangers, Uni-Strut or approved equal, where two or more horizontal conduits or EMT run parallel and at the same elevation. Secure each conduit or EMT to the horizontal hanger member by specifically designed and approved fasteners for the system used.

D. Hanger Rods: Install 1/4" diameter or larger steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit or EMT.

E. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts, to brickwork by means of expansion bolts, and to hollow masonry by means of toggle bolts. Wooden plugs and shields shall not be used. Power-driven fasteners may be used to attach pipe straps and hanger rods to concrete where approved by the Engineer. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy Fasteners of ERICO Products, Inc., or approved equal. Wire wrapped around conduits and supporting members will not be accepted. Conduit fastened to the wall above the ceiling is not acceptable.

3.3 IDENTIFICATION: Identify per Section 26 01 00, Paragraph 3.09F

3.4 CLOSING OF OPENINGS: Wherever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, including bus ducts, such openings, if unused, or the spaces left in such openings, shall be closed in a manner approved by the Engineer. All closure material along with installation methods shall retain the fire rating integrity of the surface being penetrated. All openings in walls or floors remaining after removal of existing conduits, raceways, or bus ducts shall be closed in a like, approved manner.

END OF SECTION

SECTION 26 12 00

WIRES AND CABLES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 WIRES AND CABLES (600 VOLTS)

A. Type:

Conform to the applicable UL and IPCEA Standards for the use intended. Copper conductors with 600 volt insulation unless otherwise specified or noted on the Drawings. Stranded conductors for No. 6 and larger and where elsewhere specified or noted on the Drawings.

All conductors shall be copper. Aluminum conductors will be permitted only on 600 volt and above systems.

A. Insulations: Type THHN/THWN insulation unless otherwise specified or noted on the Drawings. Type THHN/THWN minimum or type XHHW filled cross-linked polyethylene 90 degree C. thermosetting insulation for conductors larger than No. 6 and elsewhere as required by NEC. 90 degrees C. minimum insulation within fixture wireways of fluorescent fixtures.

B. Size: No. 12 minimum unless otherwise specified or noted on the Drawings. Not less than NEC requirements for the system to be installed.

C. Color Coding: Phase, neutral and ground conductors color-coded in accordance with industry standard. Connect all conductors of the same color to the same phase conductors.

	Phase A	Phase B	Phase C	Neutral
120/240V/1 Phase	Black	Red	-----	White
208Y/120V/3 Phase	Black	Red	Blue	White
277/480V/3 Phase	Brown	Orange	Yellow	Gray

Ground shall be Green for all systems.

D. Conductors No. 12 and 10 shall be solid color compounded for the entire length and each like color shall be connected only to the particular phase throughout the project. Conductor sizes larger than No. 10 may be color-coded at each termination and in each box or enclosure with six inches of half-lapped 3/4" pressure sensitive, plastic tape of respective colors in lieu of solid color compound.

2.2 VERTICAL CABLE SUPPORTS: Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used without metallic sheath.

2.3 CONNECTORS AND LUGS

A. For copper conductors No. 6 and smaller: 3M Scotch-Lok or T&B Sta-Kon, or equal compression or indent type connectors with integral or separate insulating caps.

B. For copper conductors larger than No. 6: Solderless, indent, hex screw, or bolt-type pressure connectors, properly taped or insulated.

2.4 TAPE: Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-1000. Equal to 3-M Super 88 Tape.

2.5 FEEDER CIRCUITS: Single conductor feeder cables shall be of the size and type as indicated on the Drawings. Sizes shown are for copper conductors unless otherwise noted on Drawings.

2.6 BRANCH CIRCUITS

A. Branch circuits shall be No. 12 AWG copper minimum and shall be larger AWG size where indicated on Drawings. Where branch circuits exceed 100 ft. in length, the AWG size shall be increased to accommodate voltage drop.

B. Branch circuits to all equipment, fixtures and outlets shall include a white neutral and green wire equipment ground.

PART 3 EXECUTION

3.1 WIRE AND CABLE TESTS (600 VOLTS): Measure the insulating resistance of service entrance conductors, feeder circuit conductors and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads. Tests and procedures shall meet the approval of the Engineer, and shall be in accordance with the applicable IPCEA standards for the wires and cables to be installed. Furnish all instruments, equipment and personnel required for testing, and conduct tests in the presence of the Engineer. Submit written reports of the tests and results when requested by the Engineer.

3.2 SPLICES (480 VOLTS AND UNDER): Permitted only at outlets or accessible enclosures. Conductor lengths shall be continuous from termination to termination without splices unless approved by the Engineer.

3.3 PULL WIRES: In each empty conduit, except underground conduits, install a plastic line having tensile strength of not less than 200 pounds. In each empty underground conduit, install a No. 10 AWG bare, hard-drawn copper pull wire or a plastic line having a tensile strength of not less than 200 pounds.

3.4 RACEWAYS: Install in rigid conduit, EMT or flexible metallic conduit, unless otherwise specified or noted on the Drawings.

3.5 CONDUIT BENDS: Radius or bends not less than ten times the outer diameter of the cable.

3.6 CONDUCTOR PULL: Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture collected have been swabbed out.

3.7 FEEDER IDENTIFICATION: Tag feeder circuits in each enclosure with wrap-around circuit designation labels.

3.8 CONNECTORS AND LUGS: Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.

3.9 BUNDLING: Conductors No. 10 and smaller shall be neatly and securely bundled and conductors larger than No. 10 shall be neatly and securely cabled in individual circuits, utilizing marlin twine, two-ply lacing or nylon straps.

END OF SECTION

SECTION 26 12 16

TRANSFORMERS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Wires and Cables: Section 26 12 00.

D. Wiring Devices: Section 26 14 00.

E. Cabinets: Section 26 13 30.

F. Motor and Circuit Disconnects: Section 26 17 00.

G. Fuses: Section 26 18 10.

H. Grounding: Section 26 45 00.

1.2 REQUIREMENTS: Furnish all labor, materials, service equipment and appliances required to complete the installation of the electrical distribution system in accordance with the following schedule of equipment and as described herein and shown on the Drawings.

1.3 SUBMITTALS: Submit complete shop drawings with outline dimensions, wiring diagrams, catalog cuts and descriptive literature, including no load loss, total loss, regulation at 100% and 80% power factor and net weight.

1.4 STANDARDS FOR DESIGN, MANUFACTURE AND TESTING: Standards as described in ANSI C57.12.26-2007 will be met unless otherwise specified herein.

PART 2 PRODUCTS

2.1 GENERAL: Conduit, fittings, supports, 600 volt and wiring and splices and wiring generally are covered under other sections of these Specifications.

2.2 DRY TYPE TRANSFORMERS

A. General: Size and Characteristics as shown on Drawings. Unless otherwise specified, the design, manufacture and testing of dry type transformers and methods of conducting tests and preparing reports shall be in accordance with NEMA Standard Publication for Specialty Transformers, No. ST1-4, (USASI-089). Provide separate primary and secondary windings for each phase with industry standard voltage taps. Provide with a suitable terminal compartment. The terminal compartment temperature shall not exceed 75 degrees C. when the transformer is operating continuously at rated load with ambient temperature of 40 degrees C.

B. Insulation: Class H insulation shall be rated for continuous operation of KVA with a temperature rise of not over 150 C. above a 40 C. ambient and with a maximum hot spot temperature of 220 C. Class F shall have a maximum hot spot temperature of 185

C. Enclosures: Ventilated for air cooling. Single phase transformers equal to and larger than 25 KVA and three phase transformers equal to and larger than 15 KVA shall be fully enclosed in steel enclosures. Transformers smaller than the above shall be fully enclosed, in steel enclosures, with or without compound fill, or shall have exposed cores, impregnated winding and steel enclosures enclosing all live parts.

D. Sound Rating: Noise levels, determined in accordance with NEMA standards for Specialty Transformers, shall not exceed the following: 50 dB, over 50 KVA, but less than 150 KVA.

E. Manufacturers: General Electric Hevi-Duty, Cutler-Hammer or Sorgel. If requested, the transformer manufacturer shall furnish written certification that all dry type transformers furnished by him are constructed and tested in accordance with standards referenced herein.

F. Mounting: Unless otherwise indicated on the Drawings dry type transformers having ratings not exceeding 45 KVA shall be suitable for wall mounting. Shop drawings of wall brackets and platforms for transformers having ratings exceeding 30 KVA shall be submitted for approval.

G. Noise Suppression: Mount on approved vibration and noise isolating and dampening supports. Conduit connections to transformers shall be made with flexible metal conduit, not less than 18" nor more than 36" in length.

H. Grounding: The materials, equipment, and devices related to the grounding system are specified under other sections of these Specifications.

PART 3 EXECUTION

3.1 DRY TYPE TRANSFORMER INSTALLATION

A. Separately Derived Systems: Transformers creating separately derived distribution systems such as dry type transformers shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment and secondary neutral ground. The size of grounding conductor from the transformer to the main equipment ground shall be determined by considering the transformer secondary as a service.

B. Testing: The Contractor shall test the complete grounding system with a ohm-meter at the service ground. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Engineer.

C. Grounding Connections: Clean surfaces thoroughly before applying ground lugs or clamps. If the surface is coated, the paint, enamel or lacquer must be removed. Where galvanizing is removed from metal, it shall be painted or touched up with "Galvanoz".

D. Identification: Provide engraved micarta label on front of case indicating which panel transformer is fed from and which panel it feeds.

END OF SECTION

SECTION 26 13 00

OUTLET BOXES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Construction: Zinc-coated or cadmium plated sheet steel boxes of a class to satisfy the conditions at each outlet except where unilet or condulet bodies are required. Knockout type with knockouts removed are required. Knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight sided gang boxes, 4" octagon concrete rings and 4" octagon hung ceiling boxes with bars may be folded type; one-piece deep-drawn for all other boxes. All exposed outlet boxes shall be Type FD casted boxes. Outlet boxes in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

B. Size: To accommodate the required number and sizes of conduits, wires and splices in accordance with NEC requirements, but not smaller than size shown or specified. Standard concrete type boxes not to exceed six inches deep except where necessary to permit entrance of conduits into sides of boxes without interference with reinforcing bars. Special purpose boxes shall be sized for the device or application indicated.

C. Fixture Studs: 3/8" malleable iron fixture stud in outlet boxes for ceiling lighting fixtures and interior bracket lighting fixtures, other than lamp receptacles and drop cords.

D. Exposed: Screw-joint type with gasketed weatherproof covers in locations exposed to the weather.

E. Wall-Mounted Switch, Receptacle and Signal Boxes: Unless otherwise noted or specified not less 4" square by 1-1/2" deep for 2 devices and multi-gang boxes for more than 2 devices. Boxes for switches and receptacles on unfinished walls may be screw-joint type with covers to fit the devices. Boxes installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

F. Light Fixture Boxes: 4" diameter by 1-1/2" deep minimum for ceiling and interior bracket fixtures with concealed conduits. Plaster covers for bracket fixtures to have 3" diameter openings. Screw-joint boxes with canopy seat for ceiling and interior bracket fixtures with exposed conduits. Boxes installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001

Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

G. All Boxes installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

H. Grounding Terminal: Provide a grounding terminal in each box containing a green equipment ground conductor, or serving motors, lighting fixtures or receptacles. Grounding terminal shall be green colored washer-in-head machine screw or grounding bushing.

2.2 PULLBOXES: Minimum NEC requirements unless larger box is noted. As specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches. As specified for cabinets or pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion-resistant screw or bolt attachment. Pullboxes installed in the chlorination chemical side of the building shall be rated for use in a corrosive and wet environment and shall be UL listed for that use.

2.3 WET AREA EQUIPMENT: All equipment within the buildings shall be installed in a NEMA 3R, NEMA 12 or weatherproof enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), unless otherwise noted on the drawings.

PART 3 EXECUTION

3.1 OUTLET BOXES

A. Installation: Unless otherwise specified or shown on the Drawings, outlet boxes shall be flush mounted and the front edges of the boxes or plaster covers shall be flush with the finished wall or ceiling line or if installed in walls and ceiling of incombustible construction, not more than 1/4" back of same. Mount boxes with the long axes of devices vertical, unless otherwise specified. Boxes in plastered walls and ceilings shall be provided with plaster covers. Box extensions and/or covers will not be permitted. Install in a rigid and satisfactory manner with suitable metal bar hanger, box cleats, adjustable box hangers, etc. Use wood screws on wood, expansion shields on masonry and machine screws on steel work. Boxes shall be secured to metal studs with sheet metal screws. Metal stud clips, such as Caddy “MSF”, are not acceptable. All boxes shall have far side box supports installed similar to Caddy #766.

B. Mounting Heights: The mounting height of a wall-mounted outlet box shall be construed to mean the height from the finished floor to the horizontal centerline of the cover plate. On exposed tile, block or brick construction, mount outlet boxes at the nearest bed joint to the mounting height indicated. The height of all outlets shall be at the same height when there is a secondary type wall construction along with the masonry construction. The height in the masonry construction shall be the governing factor. Verify exact height of all boxes with Engineer.

C. Wall mounted switch, receptacle and signal outlets: On columns, pilasters, etc., mount so the centers of the columns are clear for future installation of partitions. Install outlet boxes near doors or windows close to the trim. Install outlet boxes near the doors or the lock sides as shown on Architectural Drawings unless other locations are approved by the Engineer.

3.2 PULLBOXES: Provide additional pullboxes wherever necessary to meet requirements for maximum lengths of conduit runs and maximum numbers of bends per the NEC.

3.3 FIXTURE CONNECTIONS: Surface light fixtures in accessible ceilings shall be connected with minimum 1/2" flexible metallic conduits, 4 to 6 feet long with grounding provisions.

3.4 IDENTIFICATION: Identify all exposed junction and pullboxes according to the system carried by means in accordance with DIVISION – 26 01 00-3.9

END OF SECTION

SECTION 26 13 30

CABINETS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 GENERAL: Sheet steel except those exposed to wet or rain conditions that shall be raintight unless otherwise noted. Cabinets without through feeder wiring shall be arranged to provide a wiring gutter not less than 4" wide for branch circuit panelboards served by feeders up to 4/0. Panelboards served by feeders in excess of 4/0, up to and including 750 MCM, shall be provided with top, bottom and side gutters 8" wide. Panelboard cabinets in all cases shall meet or exceed the minimum requirements of Article 312 of the National Electrical Code. Cabinets shall be of standard make and shall be equal in all respects to those bearing the Underwriters Laboratories label. Cabinets, including boxes shall be made of galvanized steel. All outside surfaces of trim and doors shall be given a factory finish coat of No. 61 ANSI gray paint, or approved manufacturer's standard. Cabinet for telephone and communications systems shall have 5/8" exterior grade, one-face B-grade or equal plywood backboard inside with maximum height and width. All Cabinets within the building shall be NEMA 3R or NEMA 12 enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), and outdoor or as noted on the drawings.

2.2 FEED THROUGH GUTTERS: Where feeders go through panelboard cabinets to serve panelboards above or beyond, the wiring gutters in panelboard cabinets shall be a minimum of 8" on sides, top and bottom.

2.3 FRONTS: One piece sheet steel frame and a hinged door with catch and lock for flush cabinets. Telephone and signal cabinets for surface mounting shall be equipped with a door hinged directly to cabinet. One piece sheet steel with 3/4" flange with all edges shaped to cover edge of box. Fronts may be secured to box by means of flathead screws with captive nuts or clamps.

2.4 DOORS: Doors shall close against a rabbet placed all around the inside edge of the frame with a close fitting joint between door and frame. The doors shall be fitted with substantial flush hinges placed not over 24" apart, nor more than 6" from ends of doors, and fastened permanently to the door and frame with flat-headed rivets or spot welds, or with concealed flush piano hinges. Fastening screws of fronts shall be set not over 24" apart. Doors over 48" in height shall be equipped with a vault hinge and a three point catch.

2.5 DOOR-IN-DOOR: Both surface and flush cabinets shall be door-in-door. The door over the interior of the cabinet shall be provided with hinges and combined lock and latch. The outside door over the cabinet gutters shall have a hinge on one side, and machine screws into threaded holes in the cabinet on the other three sides. In order to insure the rigidity of the outside door, surface type

cabinets shall have a 1/2" deep lip bent over all around, with the corners welded and grounded; or in the case of flush cabinets, a steel angle frame, equivalent in strength to the bent over lip, shall be welded to the inside of the door. The outside door shall be of such size as to allow a minimum of 2-3/4" opening to all four sides of the wiring gutter. All locks shall be keyed alike.

2.6 LOCKS: Furnish each cabinet with a combination catch and flat key lock. The telephone, electrical and signal cabinet locks shall be fitted to separate keying for each system. Furnish two keys for each cabinet.

2.7 GROUND BAR: Each cabinet for a panelboard shall be provided with a copper interior ground bar suitably braced or bolted to the cabinet wall. The equipment ground bar shall be equivalent in current carrying pressure connector terminations for the associated feeders, branch circuits, etc.

PART 3 EXECUTION

3.1 CABINETS: Cables installed in the wiring gutters of cabinets shall be neatly bundled, routed and supported. Minimum bending radii as recommended by the cable manufacturer shall not be reduced. Lighting and power cabinets shall be installed with tops 6'-6" above floor or less and bottoms not less than 12" above floor. The height above floor of the highest over current device handle shall not exceed 6'-6".

3.2 SPACE: If cabinet is not shown on the plans, placement shall be appropriate for an ergonomic work area. Cabinets shall have front working clear space in accordance with OSHA regulations.

END OF SECTION

SECTION 26 14 00

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 SNAP SWITCHES: Unless otherwise specified each snap switch (flush tumbler-toggle) shall be of the AC general use type for mounting in a single-gang spacing, fully rated 20 amperes, 120-277 volts, conforming to minimum requirements of the latest revision of the Underwriters Laboratories, Inc., UL 20, Fifth Edition, Standard Snap Switches and further requirements herein specified. Industrial Specification grade, heavy duty, single pole, three way or four way, of the maintained momentary or lock type as indicated on the Drawings. Ivory color handles unless otherwise indicated on the drawings. Silver or silver alloy contacts, AC 120/277 volt general use snap switches shall be capable of withstanding tests as outlined in NEMA Publication WDI-1965, and shall be as follows unless otherwise noted:

20A120-277V AC	Hubbell	Bryant	P & S
1P	1221-I-IV	4901-I-IV	20-AC-1-I-IV
2P	1222-I-IV	4902-I-IV	20-AC-2-I-IV
3 way	1223-I-IV	4903-I-IV	20-AC-2-I-IV
4 way	1224-I-IV	4904-I-IV	20-AC-3-I-IV

2.2 RECEPTACLE

A. General: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publication WDI-1965, Part 3 and Part 10. Single or duplex as shown or noted on Drawings. Ivory color unless otherwise noted on the drawings. Double grip contacts for each prong.

B. Grounding Type: All receptacles shall be grounding type with a green colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper (based on Table 250-95 of the NEC with minimum size No. 14 AWG). Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke.

C. Unless otherwise noted, receptacles shall be as follows:

Type	Hubbell	Bryant	P&S
Spec. Grade Duplex - 20 amp	5362-I	5362-I	5362-I
GFCI, Spec. Grade Duplex - 20 amp	GF-5362-I	GFR53FT-I	2091-FI
Isolated Gnd., Orange, Spec. Grade Duplex - 20 amp	IG-5361	5361-IG	IG5366-SS
Safety Receptacle, Duplex	SG-62HI	SG-62	SG-62

D. Special: Receptacles for special applications shall be as indicated on the Drawings.

2.3 PLUG CAPS: Except for duplex receptacles and cleaning combination receptacles one matching plug cap shall be provided for each receptacle. No plug caps are required for duplex receptacles.

2.4 DEVICE PLATES

A. General: Provide device plates for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi-gang outlet plates for multi-gang boxes. Plates shall be Stainless Steel unless otherwise noted. Chlorine Room plates shall be stainless steel grade 316L or better unless otherwise noted.

B. Exposed: Plates for exposed joint fittings shall match the fittings with edges of plates flush with edges of fittings. Heavy cadmium steel plates with gasket. Plates for cast type boxes at locations subject to wet or rain conditions shall be of cast, vapor tight type. Provide hinged lift covers for devices.

C. Communication: Plates for telephone and signal outlets shall each have a 3/8" bushed opening in the center. Wall plates for push-button and buzzer outlets shall have openings to suit the push buttons and buzzers.

D. Plates for special purpose outlets shall be of a design suitable for the particular applications.

E. All plates installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

2.5 REMOTELY CONTROLLED SWITCHES OR RELAYS: Electro-magnetically operated, mechanically held unless otherwise required. Rugged construction, substantially made, conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Lighting Control Equipment. Ratings as indicated on the drawings, suitable for the application. Contacts shall be double break, renewable, solid wiping type, silver to silver or silver Tungsten alloy, self aligning, quick make, quick break, with a minimum inductive load rating of 20 amps. Relays shall be as manufactured by Allen-Bradley, ASCO, Cutler-Hammer, General Electric, Square D, or Cutler-Hammer, equal to ASCO mounting and enclosure. Device shall be mounted in a NEMA 12 or NEMA 3R enclosure as indicated on the drawings.

2.6 MOMENTARY CONTACT SWITCHES: Tumbler type single pole double throw momentary contact for 3 wire connection, with OFF position when tumbler handle is in the center, similar in appearance to the conventional snap switch. Handle or key complete as indicated on the Drawings. 20 ampere at 120-277 volts for control of 30, 60, or 100 ampere remotely controlled switches or relays rated 101 amperes and above. Provide cover plates to match the finish of other conventional snap switch plates in the area. Provide nameplate to identify the circuit or equipment controlled. Device shall be mounted in a NEMA 12 or NEMA 3R enclosure as indicated on the drawings.

2.7 ENCLOSURE: All equipment enclosures within the buildings shall be rated for wet locations (NEMA 12 or NEMA 3R as indicated on the drawings). All equipment enclosure installed in the chlorination chemical rooms shall be rated for use in a corrosive and wet environment and shall be UL listed for that use and shall be NEMA 4X.

PART 3 EXECUTION

3.1 DEVICE PLATES: Install with alignment tolerance of 1/16" and all edges in continuous contact with wall surfaces.

END OF SECTION

SECTION 26 16 00

PANELBOARDS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Cabinets: Section 26 13 30.

D. Motor and Circuit Disconnects: Section 26 17 00.

E. Fuses: Section 26 18 10.

F. Grounding: Section 26 45 00.

1.2 SUBMITTALS: Submit complete shop drawings with outline dimensions, descriptive literature and complete description of the frame size, trip setting, class and interrupting rating of all overcurrent devices. Identify available space.

PART 2 PRODUCTS

2.1 GENERAL: Dead front, safety type with voltage ratings as scheduled. Panelboards shall be of the type required for the short circuit and duty ratings indicated on the drawings. Panelboards shall be as manufactured by General Electric, ITE, Square D, or Cutler-Hammer and shall be circuit breaker or fusible type as scheduled.

2.2 CABINETS: Each panelboard shall be enclosed in a single sheet metal cabinet with front doors, catches, locks, etc., as specified in Section 26 13 30, Cabinets.

2.3 DOOR-IN-DOOR: Both surface and flush panels shall be door-in-door NEMA 3R or NEMA 12, indicated on the drawings, enclosure for non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings). The door over the interior of the panel shall be provided with hinge and combined lock and latch. The outside door over the panel gutters shall have a hinge on one side and machine screws into threaded holes in the panelboard cabinet on the other three sides. In order to insure the rigidity of the outside door, surface type panels shall have a 1/2" deep lip bent over all around with the corners welded and ground; or, in the case of flush panels a steel angle frame, equivalent in strength to the bent over lip shall be welded to the inside of the door. The outside door shall be of such size as to allow a minimum of 2-3/4" opening to all four sides of the wiring gutter or as required by NEC All locks shall be keyed alike.

2.4 BREAKERS: Molded-case or combination molded-case and current limited fuses as scheduled or required. Provide quick make and quick break toggle mechanism, inverse time trip characteristics and trip free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide a trip element for each pole, a common trip bar for all poles and a single molded insulating material handle. Handle ties will not

be accepted. Adjustable magnetic trip devices shall be set at the factory to the low trip setting. Provide breaker frame sizes as required for the continuous rating or the interrupting capacity, whichever is larger.

2.5 BOLTED TYPE: Circuit breaker current-carrying connections to the bus shall be of the bolted type, factory assembled. Stab in type not permitted. Provide bus bars for three phase panelboards of the sequence phased type connection and arranged for three-phase, four wire mains, unless otherwise indicated on the Drawings.

2.6 FUSIBLE SWITCH UNITS: Quick make, quick break type with external operation handle suitable for padlocking in OFF position. Provide interlock to prevent opening cover when switch is in ON position unless interlock release is operated. Provide switch frame sizes as required for the continuous rating or the interrupting capacity, whichever is larger. Fusible panelboards shall be UL rated and listed for service entrance where applicable.

2.7 SPACE ONLY: Where "Space Only" is noted on the drawings, provide necessary connectors, mounting brackets, etc., for the future insertion of an overcurrent device.

2.8 DIRECTORIES: Provide circuit directories on the inside face of the door of each panel.

2.9 LABELS: Labels for identifying the breakers shall be engraved laminated plastic strips attached by screws or phenolic buttons or small window frame type. Adhesive stick on labels alone will not be acceptable unless specifically approved.

2.10 SKIRTS: Where noted on the Drawings panelboards shall be skirted with complete metal enclosures and barriers separating the panel interior.

PART 3 EXECUTION

3.1 DIRECTORIES: Provide typewritten circuit descriptions referencing permanent room numbering assigned in lieu of the room numbering shown on the Drawings inserted in plastic holder. Text shall be able to be read entirely without moving the card.

3.2 CIRCUIT NUMBERING: Circuit numbering shown on the Drawings is based on pole position in the panelboard and not consecutive numbering.

3.3 PHASE ROTATION: Phase A, left bus; phase B, center bus; phase C, right bus (front viewing).

END OF SECTION

SECTION 26 17 00
MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 - PRODUCTS

2.1 DISCONNECTING MEANS

A. Safety Switches: Fusible or non-fusible Type HD quick break safety switches of the sizes and capacities indicated or required. Raintight enclosures at locations exposed to the weather.

B. Separately Enclosed Motor Snap Switches: Motor snap switches may be used for motor disconnect means, controller and motor overcurrent protection when applicable. These devices shall be horsepower rated and may contain motor running overcurrent protection.

C. Safety Type Disconnecting Switches: Heavy duty, quick make, quick break type, 250 or 600 volt rating as required for the application. Number of poles and ampacity as noted or required by code. Fusible where noted with fuse clips suitable for Buss Fusetron Class R Fuses. Short circuit rating of 200,000 RMS Amperes with CV Class R rejection feature installed in fuseholders. NEMA 1 enclosures for dry locations. NEMA 3 R enclosures for wet locations or at exposed weather locations unless otherwise noted.

2.2 MANUFACTURERS

A. General Electric, ITE, Square D, or Cutler-Hammer.

PART 3 - EXECUTION

3.1 DISCONNECT MEANS: Install in each location indicated on the Drawings and elsewhere as required by NEC.

END OF SECTION 26 17 00

SECTION 26 18 10

FUSES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Motor and Circuit Disconnect: Section 26 17 00.

D. Grounding: Section 26 45 00.

PART 2 PRODUCTS:

2.1 FUSES

A. General: Dual element, time delay type, based on heavy service, Buss Fusetron, or equal, unless otherwise noted or required for installation.

B. Current Limiting Fuses: Provide where indicated on the Drawings. For individual motor circuit protection, provide fuse sized approximately 175 percent of full load current with 100,000 amperes interrupting capacity. For non-motor feeder protection in conjunction with fused switches, install NEMA Class L fuses sized 175 percent of load current or as required for coordination with air and molded case circuit breakers, shall be furnished by the circuit breaker manufacturer.

C. Above 600 amps; Class L, "Hi-Cap" as manufactured by Bussman or approved equivalent by Chase-Shawmut or Federal Pacific.

D. Below 600 amps, as required by short circuit duty, Class K-1, "Limitron" or class K-5, "Low Peak" or Class K-5, "Fusetron" as manufactured by Bussman or approved equivalent by Chase-Shawmut or Federal Pacific.

E. All switches having current limiting fuses installed shall have a Lamicoid nameplate with white lettering on red background reading:
WARNING, REPLACE ONLY WITH CURRENT
LIMITING FUSES AS ORIGINALLY INSTALLED

2.2 COORDINATION: Coordinate the low voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

PART 3 EXECUTION

3.1 COORDINATION: Coordinate the low voltage fuses required for the project to provide basic selection protection and properly coordinate with the other associated protective equipment.

3.2 SPARE FUSES: Furnish one complete spare set of each size of fuses. Deliver to the Owner in the original boxes. It shall consist of 100% fuse replacement for all fuses required for panelboards and safety switches.

END OF SECTION

SECTION 26 19 00

RELAYS AND CONTACTORS

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Grounding: Section 26 45 00.

PART 2 PRODUCTS

2.1 GENERAL: Electromagnetically operated, electrically held unless otherwise required. Rugged construction substantially made conforming to NEMA and IEEE test standards for industrial type power relays and the requirements of UL 508, Standards for Safety Industrial Control Equipment. Relays and contactors shall be as manufactured by General Electric, ITE, Square D, or Cutler-Hammer.

2.2 RATINGS: As indicated on the Drawings or required, suitable for the application.

2.3 CONTACTS: Double break, renewable, solid wiping type, silver to silver or silver tungsten alloy, self aligning, quick make, quick break, with a minimum inductive load rating adequate for the load controlled, but not less than 25 amps.

2.4 ENCLOSURES: NEMA 3R or NEMA 12, as indicated on the drawings, for surface mounting in non-corrosive environments and NEMA 4X for corrosive environments (i.e. chemical rooms of chlorine buildings), Flush mounted with hinged door and flush latch where indicated. Sound-absorbing enclosures where located in or adjacent to occupied areas. Enclosures installed in the chlorination chemical side of the building shall be rated for use in a corrosive and wet environment and be UL listed for that use.

PART 3 EXECUTION

3.1 INSTALLATION: Install and connect in accordance with related work specified in other sections of these Specifications.

END OF SECTION

SECTION 26 27 33

CHLORINATOR INSTRUMENTATION AND CONTROLS REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section provides General Requirements applicable to Division 26.

B. Materials and methods specifications for the following:

1. Instrument Specifications.

2. Miscellaneous Electrical Items.

C. Testing, Startup, and Commissioning Requirements.

1.3 SUBMITTAL REQUIREMENTS

A. General: Submit in accordance with Division 01 00 00.

B. Shop Drawings: Submit shop drawings with arrangement and construction drawings for control panels for field installation. Include location of equipment and physical routing of wiring. Include dimensions and identification of all components. Include I/O point terminations. Show grounding layout for enclosures.

C. Catalog Data and Details: Submit catalog literature and data sheets for equipment specified in Part 2. Circle or complete manufacturer's part and model numbers; do not use highlighter. Submit data sheets per ISA S20 for each instrument.

1. Flowmeter.

2. Pressure Transducer.

3. Isolation Valves, reducers, unions, elbows, piping, etc.

4. Thermostat.

5. Intrusion Switch.

6. Limit Switch.

7. Smoke Detectors

8. Valve Controller

9. Chlorine Scale

10. Chlorine Detector

D. Material List/Schedule/Equipment List:

1. Submit list of tools required to calibrate each instrument provided under this section.

E. Installation Instructions/Methods: Submit manufacturer's installation, calibration, and test

procedures for equipment provided under this section.

F. Wiring Diagrams/Elementary Diagrams:

1. Show wiring schematics together with circuit terminations, terminal numbers, and IDs associated with the control equipment, including field devices, termination locations, surge suppressors, and relays as required.

2. Show grounding diagram for each instrument or device as applicable.

1.4 OPERATION AND MAINTENANCE SUBMITTALS

A. Maintenance and operating instructions/data: Submit Operations and Maintenance manuals for the following equipment:

1. Flowmeter.

2. Pressure Transducer.

3. Isolation Valves, reducers, unions, elbows, piping, etc.

4. Thermostat.

5. Intrusion Switch.

6. Limit Switch.

7. Smoke Detectors

8. Valve Controller

9. Chlorine Scale

10. Chlorine Detector

B. Field test results/logs/surveys/records: Submit certification that equipment supplied under this section is calibrated over specified range per manufacturer's specifications and site conditions.

C. Spare parts list: Submit list of parts with manufacturer and model number.

D. Warranties and Software Licenses: Submit manufacturer's warranty certificates for items supplied under this Division.

E. Project Record Documents: Submit as-built drawings for control panels, control devices, and field wiring. Include physical layout of equipment in cabinets, wiring diagrams, and physical routing of field wiring. Contractor shall supply start-up instructions.

1.5 QUALITY ASSURANCE

A. Conform to reference standard by date of issue current on date for receiving bids.

B. Specified reference standards are a minimum for the installation. Where the contract documents exceed the requirements of the reference standards, then the contract documents govern.

C. Schedule of References: To the extent specified elsewhere in this Division, comply with the requirements of the following standards and associations.

OSHA Occupational Safety and Health Administration
U.S. Department of Labor

Occupational Safety & Health Administration
200 Constitution Avenue
Washington, D.C. 20210

ANSI American National Standards Institute
11 West 42nd Street
New York, NY 10036

EIA Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201

FCC Federal Communications Commission
1270 Fairfield Road
Gettysburg, PA 17325

IEEE Institute of Electrical and Electronics Engineers
445 Hoes Lane
PO Box 1331
Piscataway, NJ 08855

ISA Instrument Society of America
67 Alexander Drive
PO Box 12277
Research Triangle Park, NC 27709

MIL Military Specification
Naval Publications and Forms Center
Tabor Avenue
Philadelphia, PA 19120

NEC National Electric Code
1 Batterymarch Park
Quincy, MA 02269

NEMA National Electrical Manufacturers' Association
1300 North 17th Street
Suite 1847
Rosslyn, VA 22209

NFPA National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

UBC Uniform Building Code
International Conference of Building Officials
South Workman Mill Road
Whittier, CA 90601

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

1.6 ABBREVIATION LIST

AC Alternating Current

AI	Analog Input
AO	Analog Output
AWG	American Wire Gauge
ASCII	American Standard Code for Information Interchange
bps	Bits per Second
CPU	Central Processing Unit
dB	Decibel
dBm	Decibel Referenced to Milliwatt
DC	Direct Current
DI	Digital Input
DO	Digital Output
EMT	Electrical Metallic Tubing
GPM	Gallons per minute
HOA	Hand-Off-Auto switch
IC	Instrument Cabinet
ID	Identification
I/O	Input/Output
mA	milliamperes
MAS	Multiple Address System
MB	Megabyte
MHz	Megahertz
mS	Millisecond
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
RTU	Remote Terminal Unit.
RGS	Rigid Galvanized Steel
SCADA	Supervisory Control and Data Acquisition
VAC	Volts Alternating Current
VDC	Volts Direct Current

1.7 CONTROL OPERATIONS

A. General

1. The control system configuration for the Chlorination Building at the Nahodishgish NTUA CWS Tank site provides chlorinated water to the adjacent water reservoir tank(s). The local PLC monitors the tank level via the pressure transducer installed within the existing NTUA vault, and when the Nahodishgish distribution tank level falls below a low-level set point, activates the valve controller with a single digital output which allows the flow control valve to open. The resulting water flow is measured by the flow meter, which sends a flow rate signal to the valve controller. When the valve controller detects flow above a user-adjustable minimum flow rate, the valve controller sends an enable signal to the chlorine booster pump. The valve

controller also re-transmits the flow rate signal to the PLC (to post to SCADA). The local controls automatically provide treated water to the tank. When the tank level reaches a high level set point, the PLC deactivates the valve controller enable output, causing the flow control valve to close. The consequent cessation of flow is detected by the valve controller via the flow meter, which deactivates the chlorine booster pump.

2. The control system can be enabled manually (i.e. overriding the tank level sensor) at the Chlorination Building.

B. Flow Control Valve and Controller.

1. The flow control valve is supplied with a remote electronic valve controller that controls the valve position based on operating parameters and flow rate set point (in gpm) programmed into the controller.

2. The flow rate set point is configured manually in the controller.

3. When the Nahodishgish distribution tank level falls below the Tank Low Level set point, the Local PLC sends a system enable output to the Flow Control Valve Controller to begin filling the tank.

4. The valve controller receives the system enable signal from the Local PLC, and opens the valve when operating in auto. The controller can also be operated from the front of the unit to manually initiate the valve operation.

5. The valve controller receives the flow rate from the flow meter, and adjusts the valve position to closely maintain the manually entered flow set point. The controller retransmits the flow signal directly to the local PLC. The PLC, in turn, provides the flow rate to SCADA.

6. A limit switch on the valve is open when the valve is fully closed, and closes when the valve opens, to provide a valve status indication to SCADA (via the local PLC). The limit switch is closed when the valve is in any open position.

7. The valve controller activates open and close solenoid valves to hydraulically position the flow control valve to the flow set point.

8. When the tank Nahodishgish distribution level rises above the Tank High Level set point, the local PLC sends a system disable output to the Flow Control Valve Controller to close the valve and stop filling the tank. The controller can also be operated manually to close the valve.

9. The valve is normally closed and will close upon loss of power.

10. A booster pump with pressure switch and hydro-pneumatic tank maintains the necessary hydraulic pressure to operate the hydraulically controlled flow control valve. The pressure tank shall have enough capacity to close the valve in the event of a power failure, and to prevent water from flowing to the tank without chlorination.

11. The valve controller is configured to provide an enable signal to the chlorine booster pump when flow rate (as measured by the magnetic flow meter) exceeds a user-adjustable set-point.

12. The operator can remotely, manually close the valve via SCADA. A 0-bit (“enable”) signal from SCADA allows the valve to open, close, or modulate based on tank

level and flow rate. A 1-bit ("disable") signal from SCADA closes the valve, regardless of tank level or flow rate.

C. Pressure Transmitter

1. The tank level pressure transmitter measures the tank water pressure at the base of the destination tank, and sends a 4-20mA analog pressure signal to the local PLC, which in turn sends an enable/disable signal to the valve controller based on tank level.

2. The pressure transmitter is located on a pressure tap in a vault, as indicated on the drawings.

D. Flowmeter.

1. The water flow is measured by a magnetic flowmeter, which sends a 4-20mA analog flow rate signal to the Flow Control Valve Controller (the valve controller, in turn retransmits this signal to the PLC for SCADA). The Flowmeter sends a totalizer pulse signal to the PLC. The Flowmeter is configured for unidirectional flow to the Water Tank.

2. The Flowmeter is configured with a Low Flow Cutoff, to prevent flow indication for very low flow rates.

E. Gas Chlorination System.

1. The gas chlorination system injects chlorine into the tank water supply pipe, at the chlorine building. Gas will flow whenever a vacuum is present at the injector; this vacuum is created by the chlorine booster pump.

2. The gas chlorination high/ low vacuum switch will provide two alarm signals to the PLC, indicating high and low vacuum conditions, respectively.

3. A high/low vacuum switch provides two separate alarms when the chlorine vacuum level either rises or falls below an adjustable/acceptable range.

F. Gas Chlorination Booster Pump.

1. The Booster Pump is activated by the valve controller when water flow exceeds a user-adjustable minimum flow rate.

2. A contact in the booster pump starter provides a pump running signal to the local PLC.

G. Chlorine Gas Cylinder Scale.

1. The two chlorine gas cylinders are mounted to a scale that measures the weight of each tank. The scale sends a 4-20mA signal (or digital) for each cylinder to PLC for monitoring the cylinder weight.

2. Local digital display

H. Chlorine Gas Detection System.

1. Monitors for chlorine gas leaks in the chlorine room.

2. Battery back-up.

3. Auto test module.

4. Audible and visual alarms.

5. Chlorine gas detector/receiver shall be mounted on the wall in the Chlorine room, near the chlorine gas cylinder scale, at 6'-0" above the finished floor.
6. Separate chlorine gas sensor/transmitter shall be mounted on the wall behind the chlorine gas cylinder scale at 6" above the finished floor.
7. Red strobe light, for chlorine gas leak alarm indication. Strobe light shall be installed in the Chlorine room and shall be activated by the Chlorine Gas detector/receiver when chlorine gas is detected.
8. Generates a visual alarm that is visible through the glass view window in the door. Control panel positioned so that it is hard to hit by shooting through the view window, but alarm strobe is still visible.
9. Provide warning and alarm signals to SCADA when chlorine gas is detected above user-adjustable thresholds.
10. Provides trouble signal to SCADA (via PLC) if sensor fails.

I. SCADA Inputs and Outputs (I/O):

1. Display all outputs on HMI and post to SCADA.
2. Analog Inputs to SCADA:
   a. Flow rate (in gpm)
   b. Distribution tank level (in feet)
   c. Gas cylinder weight - Cylinder #1 (in pounds)
   d. Gas cylinder weight - Cylinder #2 (in pounds)
3. Digital Inputs to SCADA:
   a. Totalized volumetric throughput (gallons)
      i. Calculated by SCADA PLC using flow totalizer pulses generated by flow meter. Meter will generate pulses on two channels. PLC will keep running tally of cumulative throughput in a register, which will be posted to SCADA.
   b. Flow control valve limit switch
   c. Chlorine booster pump running signal
   d. Chlorine gas warning
   e. Chlorine gas alarm
   f. Chlorine gas detector auto-test fault
   g. High vacuum alarm
   h. Low vacuum alarm
   i. Intrusion alarm for Chlorination Building control room door.
   j. Intrusion alarm for Chlorination Building chlorination room door.
   k. Smoke Detection
   l. Low temperature alarm

4. Digital Outputs from SCADA:
    a. Remote manual valve closure
        i. 1 causes valve to close.
        ii. 0 allows valve to open or close based on tank level and flow rate

1.8 Communications

A. The chlorinator shall communicate with the NTUA SCADA network site via fiber optic.

PART 2 PRODUCTS

2.1 CORROSION RESISTANCE:

All electrical components in the chemical room, including all equipment, enclosures, conduits, switches and any other gear, shall be rated for use in corrosive environment due to chlorine gas. Conduit, cover plates, j-boxes and fitting installed in the Chlorination Building Chemical room shall be PVC coated on the inside and outside. PVC coating must be UL6 listed and ETL-PVC-001 Verified and Labeled. PVC coating shall be a minimum of 40 mil exterior coating and 2 mil interior coating. Refer to drawings for additional PVC coating requirements.

2.2 FLOWMETER

A. Manufacturer:
    1. Elster evoQ_4
    2. Substitutions: None
B. Supplier:
    1. Meter with pulse transmitter shall be programmed by NTUA.
    2. Contractor shall coordinate submittals on flow meter, pulse transmitter and appurtenant equipment with Engineer and NTUA, and receive Engineer's approval prior to NTUA ordering materials.
    3. Contractor shall coordinate installation with NTUA.
    4. Contractor shall reimburse NTUA for materials and labor.
C. Provide flanged, electromagnetic flowmeter meeting the following requirements:
    1. Size: 4-inch
    2. Battery powered
        a. Replaceable battery
        b. 5 year minimum battery life
    3. Flange: ANSI B16.1 Class 125, epoxy coated cast iron.
    4. Liner: Polyethylene epoxy
    5. Electrodes: AISI 316 Stainless Steel
    6. Grounding Rings: AISI 316 Stainless Steel, per manufacturer's recommendations.
    7. Pressure Rating: 230 psi maximum operating pressure.

8. Sampling rate: 0.5 seconds
9. Accuracy: +/- 1.5% of true flow value through normal flow range.
10. NSF-61 Approved
11. Provided with LCD display mounted on top of meter, incorporating totalized volume, reference flow-rate, and alarm functions.
12. Manufacturers Reference: Elster evoQ_4

D. Provide pulse transmitter module meeting the following requirements:

1. Battery powered (10 year battery life)
2. Maximum load current: 20mA
3. Maximum load voltage: 30V DC
4. Pulse output: NPN signal
5. Pulse weight: Provide transmitter with Pulse Output Option G
   a. Channel 1: 1gallon
   b. Channel 2: 10 gallon
6. Channel 3: Alarm output channel will transmit signals indicating: meter low battery, pulser low battery, measurement stopped/no water, and tamper.
7. Enclosure: IP 68 / NEMA 6P
8. Operating temperature: 15°F to 120°F

E. Replacement Steel Spool

1. Contractor to provide flanged steel spool the same dimensions as flowmeter as a spare part.
2. Spool to be used to replace flowmeter, during repair.
3. Contractor to test spool prior to installing flowmeter to ensure fit.

2.3 PRESSURE TRANSMITTER

A. Manufacturer and Model:

1. Wika Type S-20, No substitutions.

B. Provide pressure transmitter meeting the following requirements:

1. Type 316 stainless steel wetted process parts.
2. 316 Stainless steel head.
3. NEMA 4/IP 67 watertight electronics housing.
4. Process connector: 1/4-inch NPT.
5. Stainless steel instrument tag, with process ID.
6. Input Power: 2-wire current loop driven by 24 VDC power supply.
7. Output Signal: 4 - 20 mA proportional to pressure over specified range.

8. Output Load: 1400 Ohms, maximum.
9. Instrument range: 0-30 psi.
10. Accuracy: ±0.5% of calibrated span.
11. Stability: ±0.2% of upper range limit per year.
12. Conduit connector: 1/2-14 NPT.
13. Electrical Connections: Screw terminals for Instrument Cable.

2.4 THERMOSTAT

A. Provide thermostat meeting the following physical requirements:
   1. Surface mount.
   2. Remote capillary, 5 foot.
   3. Setpoint dial:
      a. High limit: 55-175 °F.

B. Provide thermostat meeting the following electrical requirements:
   1. Contact Arrangement: SPDT.
   2. Contact Rating: 8A, 120 VAC.
   3. Electrical Connections: Screw terminals for Instrument Cable.
   4. Grounding: Ground housing per manufacturer's instructions.
   5. Manufacturer’s Reference: Honeywell T675A.

C. Provide two (2) redundant thermostats: one for heater/ ventilation control, and one to provide low-temperature alarm signal to PLC to be posted to SCADA.

2.5 INTRUSION SWITCH:

A. Type: Magnetic Contact.
B. Construction: Aluminum housing, with anodized aluminum finish.
C. Mounting: Integral mounting holes.
D. Maximum Voltage: 30 VDC.
E. Contact Arrangement: SPDT, Form C.
F. Gap Distance: Up to 3”.
G. Lead Type: 3’ flexible metal clad jacketed, #22 AWG.
H. Manufacturer’s Reference: Sentrol 2507-A.

2.6 LIMIT SWITCH

A. Type: Rotary operated with lever arm.
B. Enclosure: NEMA 4X and 6P
C. Contacts: 2 NO, 2 NC. Rated 600V, 10A.

D. Manufacturer's Reference: Square-D 9007C62B2, with HA2 adjustable length lever arm.

2.7 MISCELLANEOUS ELECTRICAL ITEMS

A. Selector Switches: Use NEMA-style type 4X, 1-13/64" panel cutout, oiltight/watertight rotary selector switch, screw terminal modular contact blocks.

B. Pushbutton Switches: Use NEMA-style type 4X, 1-13/64" panel cutout, oiltight/watertight unguarded flush-head or mushroom-head pushbutton switch, screw terminal modular contact blocks.

C. Pilot Lights: Use NEMA-style type 13, XLV LED Lamps, 1-13/64" panel cutout, oiltight/watertight push-to-test with transformer pilot light, screw terminal modular contact blocks.

D. Control Stations: Use NEMA type 4X, unless otherwise noted.

E. Control Relays: Provide relays meeting the following specifications:

1. General Purpose ("Ice Cube") Control Relay:

a. Contact rated NEMA B300.

b. Provide pilot light for positive indication of power to the coil.

c. DIN-rail mounted blade-style relay socket with screw terminals.

d. Coil Voltage: As required.

e. Surge protection: provide diode (DC) or capacitor/resistor (AC) at coil.

f. Contact Arrangement: Minimum DPDT.

2. Industrial Control Relays.

a. Machine tool relay with convertible screw terminal contact rated NEMA A600.

b. Coil Voltage: As required.

c. Surge protection: provide diode (DC) or capacitor/resistor (AC) at coil.

d. Contact Arrangement: Quantity and arrangement as required plus two additional contacts.

F. Control Power Transformers: Provide transformers meeting the following specifications:

1. Dry type.

2. Include one fuse block with (2) class CC and (1) 1-½ x 13/32" fuses; screw terminals.

3. Isolated secondary winding.

4. Provide 50% additional capacity above required load.

G. Overcurrent Protection: Provide overcurrent protection meeting the following specifications:

1. Incoming power protected with DIN-rail mounted circuit breaker.

2. Provide fuse protection for branch circuits.

3. Provide fuse protection and loop testing capability on 4-20 mA instrument circuits.

4. Install tag near fuseblock indicating the fuse amperage.

H. Wire Duct: Rigid PVC, slotted wall, snap-on cover, UL flammability rating 94V-0.

2.8 CONTROL PANELS AND CABINETS

A. General:

1. Provide NEMA Type 4X single-door enclosures per Section –Raceway and Boxes. Enclosure located within the Chlorination Building shall be a Nema type 4X Stainless enclosure, Saginaw P/N's SCE 36H2410SSLP or equal.

2. Size enclosures to accommodate instruments, power supplies, terminal strips, devices, wireways, wire duct, and wiring.

3. Provide wiring, wire labels, and wire terminations.

PART 3 EXECUTION

3.1 GENERAL

A. Perform work in accordance with ANSI/NFPA 70 and 79 unless otherwise specified.

B. Install equipment and products in accordance with manufacturer's instructions.

3.2 FLOWMETER INSTALLATION

A. Contractor shall coordinate furnishing and installation of AMI/AMR meters and all required appurtenances and converters in RF valve vault and surge tank building with NTUA.

1. Meters shall be programmed by NTUA.

2. Contractor shall reimburse NTUA for cost of meters from allowance.

3. NTUA shall provide fully programmed meters to Contractor.

4. Contractor shall install meters.

B. Wire magnetic flowmeter transmitter control and power wiring. Provide instantaneous flow and flow totalizer signals at surge tank building. Provide flow totalizer signal at RF valve vault.

C. Ground flowmeter and transmitter per manufacturer's recommendations. Connect transmitter ground wire to panelboard ground. Provide grounding rings.

D. Ensure wiring to AMI/AMR module in RF valve vault does not interfere with workspace in the vault. Secure wire to underside of vault lid and vault wall to keep wire out of works space and to prevent damage to wire. Ensure adequate wire slack is provided near door hinge to allow the access doors to be fully opened without damaging the wire or AMI/AMR equipment.

E. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.3 PRESSURE TRANSMITTER INSTALLATION

A. Connect pressure transmitter to associated piping.

B. Wire pressure transmitter to PLC.

C. Ground housing per manufacturer's instructions. Ground cable shield at PLC enclosure

terminal block only.

D. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.4 THERMOSTAT INSTALLATION

A. Mount thermostat 5’-0” above finish floor to centerline of switch.

B. Direct sensing tip toward center of room away from cold exterior walls. Insulate capillary tube if required to prevent cold spots.

C. Wire thermostat switch to exhaust fan control circuit.

D. Wire low temperature alarm to PLC. Calibrate and set low temperature alarm set-point.

E. Calibrate and test per manufacturer’s recommendations. Record calibration and test data.

3.5 INTRUSION SWITCH INSTALLATION

A. Locate switch in location where it is least likely to be damaged due to normal daily operations.

B. Install within specified adjusting points and per manufacturer’s recommendations.

3.6 LIMIT SWITCH INSTALLATION

A. Locate switch per Drawings and in location where it is least likely to be damaged due to normal daily operations.

B. Install within specified limits of travel and per manufacturer’s recommendations.

C. Wire limit switch to exhaust fan control circuit.

3.7 CONTROL PANEL AND CABINET FABRICATION

A. Provide space for 30% minimum spare terminal blocks in enclosures.

B. Install 15% minimum spare terminal blocks in enclosures.

C. Fabricate all enclosure holes with hydraulic punch. Do not use hole saw. Protect wiring through hole by gasketing hole per NEMA cabinet rating.

D. Mount and wire control panel equipment to terminal blocks at shop.

E. Install sub-panel in enclosure using enclosure collar studs.

F. Install interior-of-enclosure equipment without enclosure penetrations.\

G. Enclosure Wiring.

1. Wire: Use enclosure wire and instrument cable.

2. Connect analog input devices as 4-20 mA current loop in the field and in the enclosure. Coordinate analog device loop power requirements with device manufacturer.

3. Route enclosure wiring as follows:

a. Separate AC and DC wires.

b. Exposed Wire:

i. Run wire horizontally and vertically.

ii. Bundle wire with nylon tie wraps every 2 inches, minimum.

iii. Tie down wire every 4 inches, minimum.

iv. Tie down wire within 1” of each bend.

H. Wire Duct:

1. Run wire duct horizontally and vertically.
2. Provide sufficient wire duct so no more than 8” of wire is exposed.
3. Provide wire duct with slotted side walls.
4. Attach wire duct to sub-panel with mechanical fasteners.
5. Size wire duct for 50% fill.
6. Do not use nylon tie wraps inside wire duct.
7. Mount no devices in or on wire duct cover.
8. Ensure wire duct is 2” from enclosure side walls and 2” from enclosure front, minimum.

I. Hinge Wiring:

1. Secure wiring at each end so that any bending or twisting will be around the longitudinal axis of the wire.
2. Protect wire with a sleeve.

J. Interior-of-enclosure grounding: Connect ground wire from enclosure ground terminal to enclosure door stud. Remove paint from enclosure door stud where ground connections are made.

3.8 CONTROL PANEL AND CABINET INSTALLATION

A. Install control panels and cabinets per Section Raceway and Boxes.

B. Mount wall-mounted control panels and cabinets 5’-0” above finish floor to centerline of panels and cabinets. Control panels with a HMI the panel shall be mounted at 62” above finish floor to centerline of screen

C. Mount enclosures to panel equipment stanchions with nuts, bolts, lock washers, and neoprene seal washers.

D. Use a punch for any conduit penetrations. Do not use hole saw.

3.9 INSTALLATION AND START UP

A. Provide on-site supervision for installation, calibration, equipment testing, start up, and functional testing efforts.

B. Contractor shall provide all set-up, programming, and calibration of the PLC, using a programmer selected by the Owner, at Contractor’s expense. A bid allowance is provided on the Bid Form for this sole purpose.

C. Prepare process and instrument lines as follows:

1. Verify all lines which are opened during the installation are cleaned per the recommendation of the Owner.
2. Leak test all lines which are opened during the installation.

D. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.
2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

E. Test field wiring for continuity before applying power to equipment.

F. Verify voltage upstream of each overcurrent device before applying power to equipment.

G. Ensure all manual valves are OPEN and switches/breakers are ON as required for normal site operation.

H. Calibrate instruments.

3.10 SITE ACCEPTANCE TESTING

A. Prepare commissioning binder and include the following items:

1. Red-lined wiring diagrams.
2. Completed instrument data sheets.
3. Instrument Operations and Maintenance manuals.
4. Checksheets and test records.

B. Ensure sufficient spare parts and consumables are available to complete the site acceptance test.

C. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.
2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

3.11 TEST RECORDS

A. Record test results on appropriate checklists or other records that can be traced to the item and individual responsible for performing the test.

B. Identify the following on the test records:

1. Specific item tested.
2. Procedure number and revision to which the test was performed.
3. Model and serial number of any test equipment used.
4. Calibration expiration date for any test equipment used.
5. Range of Calibration.
6. Data recorder by signature or stamp.
7. Type of observation.

8. Results and acceptability.
9. Action taken in connection with any deficiencies noted.

C. When modifications, repairs or replacements are made after completion of tests, retest to the extent necessary to verify acceptability in accordance with the original plans and specifications, and to ensure compatibility with system interfaces.

3.12 TRAINING

A. Provide the following training for the Maintenance Technicians.
1. Number of Attendees: 10.
2. Duration:
a. 1/2 day formal training on-site.
3. Location: Owner's facility.
4. Topics:
a. Hands-on troubleshooting of instruments and hardware.
b. Use of test equipment.
c. Use of technical manuals for preventive and corrective maintenance.
5. Video recording of training.
6. Operate the complete system in Auto with operator(s) for at least 15 minutes.
7. Check complete system for alarm conditions.

B. Provide follow-up training 30 days after system acceptance.
1. Number of Attendees: 6.
2. Duration: 1 day.
3. Location: Owner's facility.
4. Topics: Additional Maintenance topics as required.
5. Video recording of training.

C. Text material: Use O&M Manuals and supplemental materials as required.

END OF SECTION

SECTION 26 27 34

SURGE TANK BUILDING
INSTRUMENTATION AND CONTROLS REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Water Surge Control Tanks, Section 33 12 15.

1.2 SUMMARY

A. This section provides General Requirements applicable to Division 26.

B. Materials and methods specifications for the following:

1. Instrument Specifications.

2. Miscellaneous Electrical Items.

C. Testing, Startup, and Commissioning Requirements.

1.3 SUBMITTAL REQUIREMENTS

A. **Contractor shall submit all component data and part numbers to Owner's SCADA programmer for approval prior to purchase.**

B. General: Submit in accordance with Division 01 00 00, except as noted above.

C. Shop Drawings: Submit shop drawings with arrangement and construction drawings for control panels for field installation. Include location of equipment and physical routing of the wiring. Include dimensions and identification of all components. Include I/O point terminations. Show grounding layout for enclosures.

D. Catalog Data and Details: Submit catalog literature and data sheets for equipment specified in Part 2. Circle or complete manufacturer's part and model numbers; do not use highlighter. Submit data sheets per ISA S20 for each instrument.

1. Pressure Transducer.

2. Thermostat.

3. Intrusion Switch.

4. RTU's

5. PLC's

6. Smoke Detectors

E. Material List/Schedule/Equipment List:

1. Submit list of tools required to calibrate each instrument provided under this

section.

F. Installation Instructions/Methods: Submit manufacturer's installation, calibration, and test procedures for equipment provided under this section.

G. Wiring Diagrams/Elementary Diagrams:

1. Show wiring schematics together with circuit terminations, terminal numbers, and IDs associated with the control equipment, including field devices, termination locations, surge suppressors, and relays as required.

2. Show grounding diagram for each instrument or device as applicable.

1.4 OPERATION AND MAINTENANCE SUBMITTALS

A. Maintenance and operating instructions/data: Submit Operations and Maintenance manuals for the following equipment:

1. Pressure Transducer.

2. Isolation Valves, reducers, unions, elbows, piping, etc., for the pressure transmitter pressure tap piping.

3. Thermostat.

4. Intrusion Switch.

5. RTU’s

6. PLC’s

7. Smoke Detectors

B. Field test results/logs/surveys/records: Submit certification that equipment supplied under this section is calibrated over specified range per manufacturer's specifications and site conditions.

C. Spare parts list: Submit list of parts with manufacturer and model number.

D. Warranties and Software Licenses: Submit manufacturer's warranty certificates for items supplied under this Division.

E. Project Record Documents: Submit as-built drawings for control panels, control devices, and field wiring. Include physical layout of equipment in cabinets, wiring diagrams, and physical routing of field wiring. Contractor shall supply start-up instructions.

1.5 QUALITY ASSURANCE

A. Conform to reference standard by date of issue current on date for receiving price proposal or bids.

B. Specified reference standards are a minimum for the installation. Where the contract documents exceed the requirements of the reference standards, then the contract documents govern.

C. Schedule of References: To the extent specified elsewhere in this Division, comply with the requirements of the following standards and associations.

OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Occupational Safety & Health Administration
200 Constitution Avenue
Washington, D.C. 20210

ANSI American National Standards Institute
11 West 42nd Street
New York, NY 10036

EIA Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201

FCC Federal Communications Commission
1270 Fairfield Road
Gettysburg, PA 17325

IEEE Institute of Electrical and Electronics Engineers
445 Hoes Lane
PO Box 1331
Piscataway, NJ 08855

ISA Instrument Society of America
67 Alexander Drive
PO Box 12277
Research Triangle Park, NC 27709

MIL Military Specification
Naval Publications and Forms Center
Tabor Avenue
Philadelphia, PA 19120

NEC National Electric Code
1 Batterymarch Park
Quincy, MA 02269

NEMA National Electrical Manufacturers' Association
1300 North 17th Street
Suite 1847
Rosslyn, VA 22209

NFPA National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

UBC Uniform Building Code
International Conference of Building Officials
South Workman Mill Road
Whittier, CA 90601

UL Underwriters' Laboratories, Inc.
333 Pfingston Road

Northbrook, IL 60062

1.6 ABBREVIATION LIST

AC	Alternating Current
AI	Analog Input
AO	Analog Output
AWG	American Wire Gauge
ASCII	American Standard Code for Information Interchange
bps	Bits per Second
CPU	Central Processing Unit
dB	Decibel
dBm	Decibel Referenced to Milliwatt
DC	Direct Current
DI	Digital Input
DO	Digital Output
EMT	Electrical Metallic Tubing
GPM	Gallons per minute
HOA	Hand-Off-Auto switch
IC	Instrument Cabinet
ID	Identification
I/O	Input/Output
mA	milliamperes
MAS	Multiple Address System
MB	Megabyte
MHz	Megahertz
mS	Millisecond
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
RTU	Remote Terminal Unit.
RGS	Rigid Galvanized Steel
SCADA	Supervisory Control and Data Acquisition
VAC	Volts Alternating Current
VDC	Volts Direct Current

1.7 INSTRUMENTATION OPERATIONS

A. General

1. The Reach 10.1 surge tank provides hydraulic surge protection for Reach 10.1, the Pumping Plant 12 surge tank provides hydraulic surge protection for Reach 10.2 and the Pumping Plant 13 surge tank provides hydraulic surge protection for Reach 10.3.

2. Instrumentation in the surge tank buildings consists of:

a. Smoke detector.

b. Intrusion alarm.

c. Differential pressure transducer on surge tank to indicate surge tank fill level (as 0-100% full). Refer to Section 33 12 15.

d. Low temperature alarm.

3. All instrumentation signals are transmitted to the building PLC, which posts them to the PLC's HMI and to SCADA.

4. The PLC includes an algorithm to compare actual measured flow rate to a pre-set maximum allowable flow rate, and generates an alarm if the flow rate exceeds this pre-set maximum, after an adjustable time delay. This alarm is posted to the HMI and to SCADA.

B. Outputs to SCADA (from surge tank building):

1. Analog:

a. Surge tank differential pressure transducer (0-100%)

2. Digital:

a. Intrusion alarm.

b. Smoke Detection.

c. Low pressure alarm, based on PLC algorithm comparing pressure to flow rate.

d. Low temperature alarm

C. Communications

1. The surge tank buildings associated with pump stations shall communicate with the corresponding pump station (if any).

2. The surge tank buildings shall communicate with both the NTUA SCADA network.

PART 2 PRODUCTS

2.1 THERMOSTAT

A. Physical requirements:

1. Surface mount.
2. Remote capillary, 5 foot.
3. Setpoint dial:
    a. High limit: 55-175 °F.

B. Electrical requirements:

1. Contact Arrangement: SPDT.
2. Contact Rating: 8A, 120 VAC.
3. Electrical Connections: Screw terminals for Instrument Cable.
4. Grounding: Ground housing per manufacturer's instructions.
5. Manufacturer’s Reference: Honeywell T675A.

C. Provide two (2) redundant thermostats: one for heater/ ventilation control, and one to provide low-temperature alarm signal to PLC to be posted to SCADA.

2.2 PRESSURE TRANSMITTER

A. Provide pressure transmitter meeting the following requirements:

1. Type 316 stainless steel wetted process parts.
2. Type 316 stainless steel diaphragm.
3. 316 Stainless steel head.
4. NEMA 4X watertight electronics housing.
5. Process connector: 1/2-inch NPT.
6. Stainless steel instrument tag, with process ID.
7. Input Power: 2-wire current loop driven by 24 VDC power supply.
8. Output Signal: 4 - 20 mA proportional to pressure over specified range.
9. Output Load: 1400 Ohms, maximum.
10. Instrument range: 0-100 psi.
11. Accuracy: ±0.25% of calibrated span.
12. Stability: ±0.5% of upper range limit per six months.
13. Conduit connector: 1/2-14 NPT.
14. Electrical Connections: Screw terminals for Instrument Cable.
15. Manufacturers Reference: Ametek 88C-003-A-2.

2.3 INTRUSION SWITCH:

A. Type: Magnetic Contact.

B. Construction: Aluminum housing, with anodized aluminum finish.

C. Mounting: Integral mounting holes.

D. Maximum Voltage: 30 VDC.

E. Contact Arrangement: SPDT, Form C.

F. Gap Distance: Up to 3".

G. Lead Type: 3' flexible metal clad jacketed, #22 AWG.

H. Manufacturer's Reference: Sentrol 2507-A.

2.4 PLC CONTROL PANEL

A. General

1. The PLC control panel shall be stainless NEMA 4X rated.

2. The PLC control panel shall house the following equipment:

a. Human Machine Interface (HMI)

b. PLC with I/O as specified herein

c. Power supply

d. Surge suppressor

e. Ethernet Switch: Modicon TCSESU83FN0

B. The PLC control panel shall be supplied, installed, wired and tested by manufacturer.

1. Products

a. PLC

1) The PLC shall be a chassis mount PLC designed for up to 1024 points of I/O.

2) The PLC shall:

a) Collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.

b) Be able to have its program downloaded from a remote workstation over a network, or locally programmed from a portable laptop computer.

c) Allow for the expansion of the system by addition and configuration of hardware.

d) Executive firmware shall be stored in Flash memory and can be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.

e) Each discrete point shall have a light emitting diode to indicate point status. Green shall indicate that the point is logic level "1", also referred to as "on" or "high".

f) The PLC shall utilize Ethernet protocols that meet the following:

(1) Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).

(2) Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)

g) Programming software will have embedded network configuration tools that utilize FDT/DTM technologies. PLC systems that have the PLC programming and network configuration tools in separate software will not be acceptable.

h) Each Processor shall have a USB terminal port for programming. The processor shall accept an 8Mb SD memory card. This card shall be capable of storing, at a minimum, application files, data files, PDF files, CAD files, Microsoft office files. Processor performance shall be rated at least 6,900 instructions per millisecond at a program make up of 65% Boolean and 35% numerical.

i) The processor shall be equipped with 4,096 Kb of internal user RAM and have a multi-protocol serial port, and an Ethernet port.

j) Upon power loss, the PLC shall insure memory is transferred to flash memory before PLC RAM powers down. PLCs with a battery backup will not be accepted.

k) The PLC shall have on board status lights to indicate the following various functions:

(1) Green RUN lamp that will illuminate while the program is executing

(2) Red ERR lamp that will illuminate when a fault occurs in the processor

(3) Red I/O Lamp that will illuminate upon an I/O failure or configuration fault.

(4) Yellow SER COM lamp will illuminate when activity is present on the serial port

l) A four (4) channel +/- 10V, 0-20mA, analog input card shall be provided.

m) A sixteen (16) channel sink and source 24VDC discreet input card shall be provided.

n) A sixteen (16) channel 24VDC/240VAC relay output card shall be provided. With interpose Relays used Channels

o) Communication Capabilities: The PLC shall be equipped to support the following without the need for third party modules

(1) 10/100Mb Ethernet with fast device replacement (FDR) capability, standard web page and custom web page capability. A memory card will be available to store web pages and data.

(2) Serial protocols including Modbus, Unitelway, and ASCII.

(3) Power Supplies: The PLC shall have chassis mounted power supplies to provide power for the processor and applicable modules. The power supplies shall be available in both 24 VDC and 115 VAC models. The available power ratings will be from 16 to 36W.

p) The PLC shall be an 8-slot chassis. The I/O cards will be secured to the chassis via a screw connection.

q) Programming cable: The PLC shall utilize a USB to Mini B cable for programming. This cable shall be compatible with those designed for downloading digital cameras to USB compatible PC. Accordingly, this cable shall be available through most traditional retail stores serving the consumer electronics market.

r) Alarming: The PLC shall have a configurable alarming capability. Each alarm point can be configured to display an alphanumeric message in the alarm buffer. The buffer can be displayed via a web page, or on an operator interface screen.

s) Unterminated connector cables shall have one end terminated to HE10 terminal block modules. The other end shall be unterminated to allow custom interface to panel devices.

t) Terminated connector cables shall have one end terminated to interface to terminal block, or FCN socket, cards. The other end shall be terminated to interface with HE10 terminal block modules.

u) All specified PLC platforms will be programmed using the same programming software package. PLCs that use multiple software programming packages under similar trade names will not be accepted.

v) The system shall be designed to execute all languages without a significant decrease in processing speed.

w) Programming software shall have integrated tools for network configuration, and communication capabilities. PLC's that use separate programming, communication, and network configuration software shall not be accepted.

x) The PLC must meet or exceed the following environmental requirements:

(1) Minimum temperature range:

i) Operating: -25 to +70o C (-13 to +158oF)

ii) Relative humidity: 30% to 95% non-condensing.

(2) Altitude:

i) Operation 0-7,200 feet minimum

ii) Storage 0-9,800 feet minimum

(3) Degree of protection: NEMA 1 (IP20)

(4) Vibration resistance in accordance with at least one of the following:

i) Installed rating:

(1) DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and

(2) Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.

ii) In compliance with IEC 60068 and IEC 61131.

(5) Shock resistance: 147m/s2 for 11ms.

y) The PLC's shall be designed for connection to the World Wide Web via standard and customizable web pages. Standard web pages shall display all internal status points, status registers, alarm words, and status of each I/O point. Customizable web pages shall be created by the programmer to display the actual process or machine being operated.

3) Manufacturer: The PLC, an appurtenant component, shall be manufactured by Schneider Electric, with the following model numbers:

a) PLC: Modicon M340

b) Processor: BMXP342020

c) Back plane: BMXXBP0600

d) Power supply: BMXCPS2010

e) Input Module: BMXDDI1602

f) Relay Output Module: BMXDRA1605

g) Analog Input Module: BMXAMI0410 (minimum 1 unit, additional as required for all signals)

h) Screw terminal strips: BMXFTB2010

i) Note: Each I/O Module requires one terminal strip.

j) Note: These are the minimum requirements. Confirm input modules are compatible with flowmeter and rate of flow transmitter outputs.

k) **Contractor shall submit all PLC component data and part numbers to Owner's SCADA programmer for approval prior to purchase.**

a. Human Machine Interface (HMI)

1) The HMI shall be a 5.7" color touch screen.

2) The HMI shall be TFT type providing 65,536 colors.

3) The HMI shall be equipped with built-in Ethernet TCP/IP functionality and equipped with one compact flash card slot and two USB ports.

4) The HMI shall be equipped to communicate over Ethernet via an onboard RJ45 port.

5) In addition to Ethernet communication, the HMI shall be equipped with one Sub-D9 and 1 RJ45 port for serial communication.

6) The HMI shall be a Schneider Electric Magelis Model No. HMIGTO2310, or Engineer-approved equal.

2.7 MISCELLANEOUS ELECTRICAL ITEMS

A. Selector Switches: Use NEMA-style type 4X, 1-13/64" panel cutout, oiltight/watertight rotary selector switch, screw terminal modular contact blocks.

B. Pushbutton Switches: Use NEMA-style type 4X, 1-13/64" panel cutout, oiltight/watertight unguarded flush-head or mushroom-head pushbutton switch, screw terminal modular contact blocks.

C. Pilot Lights: Use NEMA-style type 13, XLV LED Lamps, 1-13/64" panel cutout, oiltight/watertight push-to-test with transformer pilot light, screw terminal modular contact blocks.

D. Control Stations: Use NEMA type 4X, unless otherwise noted.

E. Control Relays: Provide relays meeting the following specifications:

1. General Purpose ("Ice Cube") Control Relay:

a. Contact rated NEMA B300.

b. Provide pilot light for positive indication of power to the coil.

c. DIN-rail mounted blade-style relay socket with screw terminals.

d. Coil Voltage: As required.

e. Surge protection: provide diode (DC) or capacitor/resistor (AC) at coil.

f. Contact Arrangement: Minimum DPDT.

2. Industrial Control Relays.

a. Machine tool relay with convertible screw terminal contact rated NEMA A600.

b. Coil Voltage: As required.

c. Surge protection: provide diode (DC) or capacitor/resistor (AC) at coil.

d. Contact Arrangement: Quantity and arrangement as required plus two additional contacts.

e. Control Power Transformers: Provide transformers meeting the following specifications:

3. Dry type.

4. Include one fuse block with (2) class CC and (1) 1-½ x 13/32" fuses; screw terminals.

5. Isolated secondary winding.

6. Provide 50% additional capacity above required load.

F. Overcurrent Protection: Provide overcurrent protection meeting the following specifications:

1. Incoming power protected with DIN-rail mounted circuit breaker.

2. Provide fuse protection for branch circuits.

3. Provide fuse protection and loop testing capability on 4-20 mA instrument circuits.

4. Install tag near fuseblock indicating the fuse amperage.

G. Wire Duct: Rigid PVC, slotted wall, snap-on cover, UL flammability rating 94V-0.

2.8 CONTROL PANELS AND CABINETS

A. General:

1. Provide NEMA Type 4X single-door enclosures per Section –Raceway and Boxes. Enclosure located within the surge tank building shall be a NEMA type 4X

Stainless enclosure, Saginaw P/N's SCE 36H2410SSLP or equal.

2. Size enclosures to accommodate instruments, power supplies, terminal strips, devices, wireways, wire duct, and wiring.

3. Provide wiring, wire labels, and wire terminations.

PART 3 EXECUTION

3.1 GENERAL

A. Perform work in accordance with ANSI/NFPA 70 and 79 unless otherwise specified.

B. Install equipment and products in accordance with manufacturer's instructions.

3.2 THERMOSTAT INSTALLATION

A. Mount thermostat 5'-0" above finish floor to centerline of switch.

B. Direct sensing tip toward center of room away from cold exterior walls. Insulate capillary tube if required to prevent cold spots.

C. Wire thermostat switch to exhaust fan control circuit.

D. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.3 INTRUSION SWITCH INSTALLATION

A. Locate switch in location where it is least likely to be damaged due to normal daily operations.

B. Install within specified adjusting points and per manufacturer's recommendations.

3.4 CONTROL PANEL AND CABINET FABRICATION

A. Provide space for 30% minimum spare terminal blocks in enclosures.

B. Install 15% minimum spare terminal blocks in enclosures.

C. Fabricate all enclosure holes with hydraulic punch. Do not use hole saw. Protect wiring through hole by gasketing hole per NEMA cabinet rating.

D. Mount and wire control panel equipment to terminal blocks at shop.

E. Install sub-panel in enclosure using enclosure collar studs.

F. Install interior-of-enclosure equipment without enclosure penetrations.\

G. Enclosure Wiring.

1. Wire: Use enclosure wire and instrument cable.

2. Connect analog input devices as 4-20 mA current loop in the field and in the enclosure. Coordinate analog device loop power requirements with device manufacturer.

3. Route enclosure wiring as follows:

a. Separate AC and DC wires.

b. Exposed Wire:

i. Run wire horizontally and vertically.

ii. Bundle wire with nylon tie wraps every 2 inches, minimum.

iii. Tie down wire every 4 inches, minimum.

iv. Tie down wire within 1” of each bend.

H. Wire Duct:

1. Run wire duct horizontally and vertically.

2. Provide sufficient wire duct so no more than 8” of wire is exposed.

3. Provide wire duct with slotted side walls.

4. Attach wire duct to sub-panel with mechanical fasteners.

5. Size wire duct for 50% fill.

6. Do not use nylon tie wraps inside wire duct.

7. Mount no devices in or on wire duct cover.

8. Ensure wire duct is 2” from enclosure side walls and 2” from enclosure front, minimum.

I. Hinge Wiring:

1. Secure wiring at each end so that any bending or twisting will be around the longitudinal axis of the wire.

2. Protect wire with a sleeve.

J. Interior-of-enclosure grounding: Connect ground wire from enclosure ground terminal to enclosure door stud. Remove paint from enclosure door stud where ground connections are made.

3.5 CONTROL PANEL AND CABINET INSTALLATION

A. Install control panels and cabinets per Section Raceway and Boxes.

B. Mount wall-mounted control panels and cabinets 5’-0” above finish floor to centerline of panels and cabinets. Control panels with a HMI the panel shall be mounted at 62” above finish floor to centerline of screen

C. Mount enclosures to panel equipment stanchions with nuts, bolts, lock washers, and neoprene seal washers.

D. Use a punch for any conduit penetrations. Do not use hole saw.

3.6 INSTALLATION AND START UP

A. Provide on-site supervision for installation, calibration, equipment testing, start up, and functional testing efforts.

B. Contractor shall provide all set-up, programming, and calibration of the PLC, using a programmer selected by the Owner, at Contractor's expense. A bid allowance is provided on the Bid Form for this sole purpose.

C. Prepare process and instrument lines as follows:

1. Verify all lines which are opened during the installation are cleaned per the recommendation of the Owner.

2. Leak test all lines which are opened during the installation.

D. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.

2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

E. Test field wiring for continuity before applying power to equipment.

F. Verify voltage upstream of each overcurrent device before applying power to equipment.

G. Ensure all manual valves are OPEN and switches/breakers are ON as required for normal site operation.

H. Calibrate instruments.

3.7 SITE ACCEPTANCE TESTING

A. Prepare commissioning binder and include the following items:

1. Red-lined wiring diagrams.

2. Completed instrument data sheets.

3. Instrument Operations and Maintenance manuals.

4. Check sheets and test records.

B. Ensure sufficient spare parts and consumables are available to complete the site acceptance test.

C. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.

2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

3.8 TEST RECORDS

A. Record test results on appropriate checklists or other records that can be traced to the item and individual responsible for performing the test.

B. Identify the following on the test records:

1. Specific item tested.

2. Procedure number and revision to which the test was performed.

3. Model and serial number of any test equipment used.
4. Calibration expiration date for any test equipment used.
5. Range of Calibration.
6. Data recorder by signature or stamp.
7. Type of observation.
8. Results and acceptability.
9. Action taken in connection with any deficiencies noted.

C. When modifications, repairs or replacements are made after completion of tests, retest to the extent necessary to verify acceptability in accordance with the original plans and specifications, and to ensure compatibility with system interfaces.

3.9 TRAINING

A. Provide the following training for the Maintenance Technicians.

1. Number of Attendees: 10.
2. Duration:
   a. 1 day formal training onsite.
3. Location: Owner's facility.
4. Topics:
   a. Hands-on troubleshooting of instruments and hardware.
   b. Use of test equipment.
   c. Use of technical manuals for preventive and corrective maintenance.
5. Video recording of training.
6. Operate the complete system in Auto with operator(s) for at least 15 minutes.
7. Check complete system for alarm conditions.

B. Provide follow-up training 30 days after system acceptance.

1. Number of Attendees: 6.
2. Duration: 1 day.
3. Location: Owner's facility.
4. Topics: Additional Maintenance topics as required.
5. Video recording of training.

C. Text material: Use O&M Manuals and supplemental materials as required.

END OF SECTION

SECTION 26 27 35

PRESSURE TRANSDUCER INSTRUMENTATION AND CONTROLS REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section provides General Requirements applicable to Division 26.

B. Materials and methods.

C. Testing, Startup, and Commissioning Requirements.

1.3 SUBMITTAL REQUIREMENTS

A. General: Submit in accordance with Division 01 00 00.

B. Pressure Transducer Catalog Data and Details: Submit catalog literature and data sheets for equipment specified in Part 2. Circle or complete manufacturer's part and model numbers, Submit data sheets per ISA S20 for each instrument.

C. Installation Instructions/Methods: Submit manufacturer's installation, calibration, and test procedures for equipment provided under this section.

D. Wiring Diagrams/Elementary Diagrams:

1. Show wiring schematics together with circuit terminations, terminal numbers, and IDs associated with the control equipment, including field devices, termination locations, surge suppressors, and relays as required.

2. Show grounding diagram for each instrument or device as applicable.

1.4 OPERATION AND MAINTENANCE SUBMITTALS

A. Maintenance and operating instructions/data: Submit Operations and Maintenance manual for pressure transducer.

B. Field test results/logs/surveys/records: Submit certification that equipment supplied under this section is calibrated over specified range per manufacturer's specifications and site conditions.

C. Warranties and Software Licenses: Submit manufacturer's warranty certificates for items supplied under this Division.

D. Project Record Documents: Submit as-built drawings for control panels, control devices, and field wiring. Include physical layout of equipment in cabinets, wiring diagrams, and physical routing of field wiring. Contractor shall supply DVD of start-up instructions.

1.5 QUALITY ASSURANCE

A. Conform to reference standard by date of issue current on date for receiving bids.

B. Specified reference standards are a minimum for the installation. Where the contract documents exceed the requirements of the reference standards, then the contract documents govern.

C. Schedule of References: To the extent specified elsewhere in this Division, comply with the requirements of the following standards and associations.

OSHA Occupational Safety and Health Administration
U.S. Department of Labor
Occupational Safety & Health Administration
200 Constitution Avenue
Washington, D.C. 20210

ANSI American National Standards Institute
11 West 42nd Street
New York, NY 10036

EIA Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201

FCC Federal Communications Commission
1270 Fairfield Road
Gettysburg, PA 17325

IEEE Institute of Electrical and Electronics Engineers
445 Hoes Lane
PO Box 1331
Piscataway, NJ 08855

ISA Instrument Society of America
67 Alexander Drive
PO Box 12277
Research Triangle Park, NC 27709

MIL Military Specification
Naval Publications and Forms Center
Tabor Avenue
Philadelphia, PA 19120

NEC National Electric Code
1 Batterymarch Park
Quincy, MA 02269

NEMA National Electrical Manufacturers' Association
1300 North 17th Street
Suite 1847
Rosslyn, VA 22209

NFPA National Fire Protection Association
Batterymarch Park
Quincy, MA 02269

UBC Uniform Building Code
International Conference of Building Officials
South Workman Mill Road

Whittier, CA 90601

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

1.6 ABBREVIATION LIST

AC	Alternating Current
AI	Analog Input
AO	Analog Output
AWG	American Wire Gauge
ASCII	American Standard Code for Information Interchange
bps	Bits per Second
CPU	Central Processing Unit
dB	Decibel
dBm	Decibel Referenced to Milliwatt
DC	Direct Current
DI	Digital Input
DO	Digital Output
EMT	Electrical Metallic Tubing
GPM	Gallons per minute
HOA	Hand-Off-Auto switch
IC	Instrument Cabinet
ID	Identification
I/O	Input/Output
mA	milliamperes
MAS	Multiple Address System
MB	Megabyte
MHz	Megahertz
mS	Millisecond
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
RTU	Remote Terminal Unit.
RGS	Rigid Galvanized Steel
SCADA	Supervisory Control and Data Acquisition
VAC	Volts Alternating Current
VDC	Volts Direct Current

1.7 CONTROL OPERATIONS

A. General

1. The BBN9 Reach 10.1, 10.2 & 10.3 project includes four (4) pressure transducers,

one (1) located inside of the control valve vault at the Pumping Plant 12 (PP12) Regulating Tank site, one (1) at the Pumping Plant 13 (PP13) Regulating Tanks and two (2) at the Nahodishgish Tank site. At the Nahodishgish Tank site, one (1) pressure transducer is monitoring the proposed Nahodishgish Regulating tanks and one (1) is monitoring the existing NTUA Nahodishgish CWS distribution tank.

2. These pressure transmitters measure the tank water pressure at the base of the tank and sends a 4-20mA analog pressure signal to the local PLC.

3. PP12 Regulating Tank Pressure Transducer

   a. The pressure transmitter at the PP12 Regulating Tank site is hardwired to PP12's PLC and posts the tank level to SCADA. PP12 monitors the PP12 Regulating Tank level to ensure PP12 has adequate suction pressure.

4. PP13 Regulating Tank Pressure Transducer

   a. The pressure transmitter at the PP13 Regulating Tank site is hardwired to PP13's PLC and posts the tank level to SCADA. PP13 monitors the PP13 Regulating Tank level to ensure PP13 has adequate suction pressure. PP12 monitors the PP13 Regulating tank levels via SCADA and starts up / shuts down based upon the PP13 Regulating Tanks levels.

5. Nahodishgish Regulating Tank Pressure Transducer

   a. The pressure transmitter at the Nahodishgish Regulating Tank site is hardwired to the Nahodishgish Chlorinator's PLC and posts the tank level to SCADA. PP13 monitors the Nahodishgish Regulating tank levels via SCADA and starts up / shuts down based upon the Nahodishgish Regulating Tanks levels. Nahodishgish Chlorinator PLC monitors the Nahodishgish Regulating tank levels to ensure a minimum level is maintained.

6. Nahodishgish Distribution Tank Pressure Transducer

   a. The pressure transmitter at the Nahodishgish Distribution Tank site is hardwired to the Nahodishgish Chlorinator's PLC and posts the tank level to SCADA. The Chlorinator's PLC monitors the Nahodishgish Distribution tank level and modulates the control valve in the chlorinator building based upon the Nahodishgish Distribution Tank level. Refer to Technical Specification 26 27 33 Chlorinator Instrumentation and Controls Requirements.

B. SCADA Inputs and Outputs (I/O):

1. Pressure transducer to be hard wired to the local PLC as described above or as shown on the Construction Drawings.

2. Display all outputs on HMI and post to SCADA.

3. Analog Inputs to SCADA:

   a. Tank level (in feet)

1.8 Communications

A. Refer to Technical Specification 27 43 30 SCADA Telemetry System.

PART 2 PRODUCTS

2.1 PRESSURE TRANSMITTER

A. Manufacturer and Model:

1. Wika Type S-20, No substitutions.

B. Provide pressure transmitter meeting the following requirements:

1. Type 316 stainless steel wetted process parts.
2. 316 Stainless steel head.
3. NEMA 4/IP 67 watertight electronics housing.
4. Process connector: 1/4-inch NPT.
5. Stainless steel instrument tag, with process ID.
6. Input Power: 2-wire current loop driven by 24 VDC power supply.
7. Output Signal: 4 - 20 mA proportional to pressure over specified range.
8. Output Load: 1400 Ohms, maximum.
9. Instrument range: 0-30 psi.
10. Accuracy: 0.5% of calibrated span.
11. Stability: 0.2% of upper range limit per year.
12. Conduit connector: 1/2-14 NPT.
13. Electrical Connections: Screw terminals for Instrument Cable.

PART 3 EXECUTION

3.1 GENERAL

A. Perform work in accordance with ANSI/NFPA 70 and 79 unless otherwise specified.

B. Install equipment and products in accordance with manufacturer’s instructions.

3.2 PRESSURE TRANSMITTER INSTALLATION

A. Connect pressure transmitter to associated piping.

B. Wire pressure transmitter to PLC.

C. Ground housing per manufacturer's instructions. Ground cable shield at PLC enclosure terminal block only.

D. Calibrate and test per manufacturer's recommendations. Record calibration and test data.

3.3 INSTALLATION AND START UP

A. Provide on-site supervision for installation, calibration, equipment testing, start up, and functional testing efforts.

B. Contractor shall provide all set-up, programming, and calibration of the PLC, using a programmer selected by the Owner, at Contractor’s expense. A bid allowance is provided on the Bid Form for this sole purpose.

C. Prepare process and instrument lines as follows:

1. Verify all lines which are opened during the installation are cleaned per the recommendation of the Owner.
2. Leak test all lines which are opened during the installation.

D. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.
2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

E. Test field wiring for continuity before applying power to equipment.

F. Verify voltage upstream of each overcurrent device before applying power to equipment.

G. Ensure all manual valves are OPEN and switches/breakers are ON as required for normal site operation.

H. Calibrate instruments.

3.4 SITE ACCEPTANCE TESTING

A. Prepare commissioning binder and include the following items:

1. Red-lined wiring diagrams.
2. Completed instrument data sheets.
3. Instrument Operations and Maintenance manuals.
4. Check sheets and test records.

B. Verify installation of each instrument as follows:

1. Ensure the model number of instrument installed matches the submittal data.
2. Review the completed installation of instrument, referencing the manufacturer's recommendations.

3.5 TEST RECORDS

A. Record test results on appropriate checklists or other records that can be traced to the item and individual responsible for performing the test.

B. Identify the following on the test records:

1. Specific item tested.
2. Procedure number and revision to which the test was performed.
3. Model and serial number of any test equipment used.
4. Calibration expiration date for any test equipment used.
5. Range of Calibration.
6. Data recorder by signature or stamp.
7. Type of observation.
8. Results and acceptability.
9. Action taken in connection with any deficiencies noted.

C. When modifications, repairs or replacements are made after completion of tests, retest to the extent necessary to verify acceptability in accordance with the original plans and specifications, and to ensure compatibility with system interfaces.

END OF SECTION

SECTION 26 42 10

IMPRESSED CURRENT CATHODIC PROTECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Design, furnish, install, energize, adjust, and test an automatically controlled, impressed current, cathodic protection system, for the interior of a steel reservoir complete as described herein.

B. Coordinate related work included in other Sections.

C. Cathodic protection system shall include wire, conduit and related appurtenances to complete the connection of the cathodic protection system to the power source and all other related structures and connections.

1.2 QUALITY ASSURANCE

A. Obtain complete impressed current cathodic protection system from one system supplier.

B. Conform to the recommendations of the National Association of Corrosion Engineers (NACE).

C. Conform to ANSI/AWWA D104-11.

D. Conform to National Electric Code.

1.3 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this Section with minimum five years documented experience.

B. Design work by parties certified by a NACE Cathodic Protection Specialist, certified and licensed at location of project.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Submit for review detailed calculations, drawings and data documenting the sizing of the cathodic protection system components including, but not limited to: anode, rectifier, batteries, potential control devices, electrical cable, conduits, reference cells, cable connectors, connection insulation, anode suspension ropes, installation arrangement and details.

1. Contractor shall submit a copy of Installer’s registration as a NACE Cathodic Protection Specialist.
2. Contractor shall submit a materials certificate verifying ANSI/NSF 61 classification for all wetted system components.

C. Contractor may submit minor variations to the proposed system for Engineer and Owner approval, prior to installation.

D. Submit Final Certified Operations Report.

E. Submit a Cathodic Protection System Service Agreement in writing that meets the requirements of this Section. The reviewed and accepted agreement must be signed by the NACE-certified CP system provider as a pre-requisite to final payment for the project.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Basic Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of all system components.

C. Operation and Maintenance Data: Include periodic test procedures.

PART 2 PRODUCTS

2.1 GENERAL

A. A complete impressed current cathodic protection system consisting of a platinized niobium wire anode loop within the reservoir, an electrical system capable of meeting the requirements of the cathodic protection system and providing power to a device for level measurement, control equipment and devices necessary to maintain constant tank-to-water potential, and facilities as required to monitor system performance.

B. An automatic control system to provide completely unattended operation under all normal operating conditions. Design the system with the capability of automatically maintaining a selected constant potential at the locations monitored by its reference device or devices under all normal operation conditions.

C. Provide an impressed current cathodic protection system that is fully protected against abnormal conditions such as those that result from lightning strikes, internal system short circuits, or overloads.

D. All materials potentially in contact with water or in the condensation area shall conform to ANSI/NSF 61.

2.2 TANK-TO-WATER POTENTIAL CONTROL DEVICES

A. Include control devices of solid-state design capable of maintaining a constant tank-to-water potential within the tank of minus 900 millivolts, with a maximum potential variation less than 20 millivolts, or as determined by the Contractor’s NACE-certified CP system designer. Provide control devices free of errors produced by IR drop.

B. Provide control devices that do not require manual tap adjustment to maintain output of impressed current through the full rated output current range of the device.

C. Circuit the potential control device so that its measuring circuit is sensitive only to the potential of the metal surface being protected and is unaffected by voltage drops occasioned by the flow of protective current through the various components between the power source and the metal surface being protected.

D. Furnish potential control devices with demonstrated satisfactory performance in a similar installation for at least two years.

E. Mount the potential control devices with rectifier in a NEMA 3R enclosure.

2.3 MONITORING REFERENCE CELLS

A. Furnish two removable monitoring reference cells.

B. Installed location of both reference cells shall be determined by the Contractor's NACE-certified CP system designer.

C. Run reference cell lead wires in rigid galvanized conduit on the exterior of the tank shell from the tank roof to the rectifier unit.

D. Locate roof penetrations for cells near tank roof hatch to provide access to cells. Clearly and permanently identify the terminals to which the connecting cables from these cells are terminated.

2.4 POTENTIAL MEASUREMENT OPENINGS

A. Provide potential measurement openings with gasketed covers in each quadrant where highest and lowest structure-to-water potentials are expected to be found.

2.5 ELAPSED TIME METER

A. Provide elapsed time meter(s) that operate when the potential control device is operating and supplying protective current to the tank.

2.6 IMPRESSED CURRENT ANODE SEGMENTS

A. Provide anodes with connection wire of platinized niobium wire sized for 20-year service life.

B. The anode system will be designed for the specified service life, based on an assumption that 25% of interior surface area of tank below high water level is bare and free of protective coatings.

2.7 ELECTRICAL CABLE

A. Stranded copper with 600-volt insulation.

B. Type THWN insulation for cable that will never be submerged.

C. Anaconda type CP, cathodic protection cable with low density, high molecular weight polyethylene insulation for any cable that might be submerged.

2.8 CONDUIT

A. Flexible conduit shall be used.

2.9 REFERENCE CELLS

A. Copper saturated copper sulfate solution type guaranteed for twenty-year service life.

2.10 CABLE CONNECTORS

A. Use copper compression connectors for splices in cable runs and at anode connection.

2.11 ANODE SUSPENSION ROPES

A. Nylon or Engineer approved substitute.

2.12 ANODE CABLE ROUTING

A. Route anode cables through the reservoir sidewall by means of a pressure entrance fitting nominally two feet above ring-wall.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the cathodic protection system in accordance with reviewed and approved submittals.

B. Furnish technically competent superintendent and experienced employees, each with at least five years of documented experience on similar installations, as required to accomplish the cathodic protection system installation in a prompt and effective manner.

C. Install all equipment level and plumb and located for easy maintenance access. Install conduit parallel to dominant structure surfaces and supported at intervals of not more than five feet.

D. Provide a separate positive DC output cable to each anode wire loop.

E. Clearly and permanently identify each terminal as to the anode ring or section of the ring supplied by the feeder cable connected to that terminal.

F. Install the anode ring at a height of 8 to 10 feet above the floor of the tank. Exact height to be determined by the Contractor's NACE-certified CP system designer.

G. Install all interconnecting conductors and cables external to the reservoir in conduit.

H. Route conductors and cables between devices located external to the reservoir and components located internal to the reservoir to minimize conductors and cables within the reservoir.

I. Complete all welding and cutting for installation of cathodic protection equipment, devices, and raceways prior to coating tank. In the event that welding or cutting is required after tank coating, internal coating shall be repaired in accordance with Section 09 97 14 – Water Storage Tank Painting.

3.2 ENERGIZING, ADJUSTING, AND TESTING

A. The system shall be fully energized, adjusted, and tested within one month after the completion of the project's 11-month inspection.

B. Fill reservoir to normal capacity and maintain level throughout the cathodic protection adjustment period.

C. Energize the cathodic protection system and adjust the system for optimum performance based on tank-to-water potential readings at various locations within the reservoir.

D. Set controls for minimum output and increase manually until protective levels approach those required for protection.

E. When the tank-to-water potential measured with each monitoring reference cell is at least 0.85 volts, make tank-to-water potential measurements at four-foot intervals from the tank bottom to the high water line at each potential measurement opening. Record each

measurement. Adjust output until no tank-to-water potential is greater than 1.00 volts nor less than 0.85 volts, or as determined by Contractor's NACE-certified CP system designer.

F. After the initial tank-to-water potential adjustments are complete, switch to automatic potential control.

G. Between 24 hours and 72 hours after completion of initial adjustment, make final adjustments using the same procedure as during the initial adjustment.

H. Provide the Engineer with a Final Certified Operations Report documenting all control device settings and potential measurements.

3.3 Cathodic Protection System Service Agreement: Provide an agreement for five (5) years of service for the tank cathodic protection system, starting upon the date of energizing the cathodic protection system. The agreement would require completion of the following service and testing on an annual basis, meeting or exceeding the minimum requirements of AWWA D104-11.

A. The service agreement shall be directly between the NACE-certified CP system provider and NTUA.

B. The cost of the services provided by the agreement shall be incidental to the cost of the tank cathodic protection system. Payment to the NACE-certified CP system provider for the service agreement shall be the responsibility of the Contractor.

C. Owner reserves right to reject service provider for any reason and require Contractor to provide another service provider acceptable to the Owner.

D. Annual service:

1. Wiring, anodes, rectifier, fuses, and accessories shall be observed and electrical measurements shall be taken to test anodes and reference cells.

2. Any damage or deficiencies with the cathodic protection system should be noted for correction.

3. Any handhole covers, gaskets, and bolts shall be positioned to fully cover any handhole and bolt hole openings in the roof.

4. The Contractor shall forward certified results of the evaluation and recalibration of the cathodic protection system to the Owner.

E. Annual testing:

1. The Contractor shall perform tank-to-water potential profile measurements to verify the effectiveness of the cathodic protection system.

2. The testing shall show changes in metal potential for all wetted surfaces of the tank interiors measured against a calibrated portable reference cell.

3. Measurements shall be made at a minimum of five separate locations per tank.

4. The Contractor shall submit copies of the tabulated results of the test to the Owner.

END OF SECTION

SECTION 26 45 00

GROUNDING

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

B. General Electrical Provisions: Section 26 01 00.

C. Raceways: Section 26 11 00.

D. Outlet Boxes: Section 26 13 00.

E. Wires and Cables: Section 26 12 00.

F. Wiring Devices: Section 26 14 00.

G. Cabinets: Section 26 13 30.

H. Motor and Circuit Disconnects: Section 26 17 00.

I. Panelboards: Section 26 16 00.

PART 2 PRODUCTS

2.1 Materials, equipment and devices related to the grounding system are specified under other sections of these Specifications.

PART 3 EXECUTION

3.1 GENERAL: Install two separate grounding systems, a service grounding system and an equipment grounding system. The service equipment, conduit systems, supports, cabinets, equipment, and neutral conductor shall be grounded in accordance with the minimum code requirements and as further indicated on the Drawings or as specified. Connect the two grounding systems together only at the main service equipment and at the secondary terminals of transformers creating separately derived distribution systems such as dry-type transformers.

3.2 SERVICE GROUNDING SYSTEM

A. General: The service grounding system is provided for the AC service neutral ground. Current return conductors, such as neutrals of the service entrance, feeder circuits and branch circuits, shall not be used for equipment grounding. Care must be exercised to ensure that neutral bars are not bonded to the enclosures of panelboards, etc., which are not part of the main service equipment. Except for separately derived systems, the neutral conductors shall be grounded only in the main service equipment.

B. Common Ground Point: Establish one common ground point in the main service equipment by interconnecting the insulated neutral bus (or bar), the uninsulated equipment ground bus (or bar), and service grounding electrode conductor.

C. Neutral Disconnecting Means: Install a neutral disconnecting means in the main service equipment for disconnecting and isolating the neutral bus from the common ground. The disconnecting means may be disconnecting links in the interconnection between the insulated neutral and uninsulated equipment ground.

D. Neutral Bars: Provide an insulated neutral bar, separate from the uninsulated equipment ground bar, in all panelboards, transformers, starters, disconnect switches, cabinets, etc., which have neutral connections.

3.3 EQUIPMENT GROUNDING SYSTEM

A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements and as further indicated on the Drawings or specified. The equipment ground (green conductor) consists of metallic connections to ground of non-current-carrying metal parts of the wiring system or apparatus connected to the system. The primary purpose of equipment grounding is to provide greater safety by limiting the electrical potential between non-current-carrying parts of the system and to provide a low impedance path to ground for possible ground fault currents.

B. Common Ground Point: Establish one common ground point as specified elsewhere in this section of the specifications for interconnection of the equipment grounding system and the service grounding electrode conductor.

C. Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground box (or bar) with a conductor or bar sized for 50% of the largest service overcurrent device.

D. Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all panelboards, starters, disconnect switches, cabinets, etc. for grounding the enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in panelboards or a separately mounted bar adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to assure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.

E. Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring only shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in each nonmetallic conduit or duct except those used for telephone, sound, or low voltage signals and in all flexible conduit that does not have a built-in ground conductor. Bond the conductor at both ends to the equipment grounding system.

F. Feeders and Branch Circuits: Provide a separate green insulated equipment grounding conductor for each single or three phase feeder and each branch circuit with a three phase protective device. Provide a separate green insulated equipment grounding conductor for single phase branch circuits where indicated on the Drawings. Install the required grounding conductor in the common conduit or raceway with the related phase and/or neutral conductors and connect to the box or cabinet grounding terminal. Where there are parallel feeders

installed in more than one raceway each raceway shall have a green insulated equipment ground conductor installed.

G. Devices: Install a minimum No. 12 green insulated equipment bonding conductor from a grounding terminal in the respective outlet or junction box to the green ground terminal of all receptacles and through flexible conduit to all light fixture housings and other fixed equipment.

H. Motors: Install a separate green insulated equipment grounding conductor from the equipment ground bar in the motor control center or separate starter through the conduit and flexible conduit to the ground terminal in the connection box mounted on the motor. Install the grounding conductor in the common conduit or raceway with the related motor circuit conductors.

3.4 SEPARATELY DERIVED SYSTEMS: Transformers creating separately derived distribution systems, such as dry type transformers, shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground with separate grounding conductor extended to an approved ground electrode.

3.5 GROUNDING ELECTRODES: Two service ground electrodes shall be utilized. One shall be the main cold water metallic water piping system and the other shall be a made electrode consisting of not less than twenty feet of bare copper conductor encased along the bottom of a concrete foundation footing which is in direct contact with the earth (NEC 250-50). Make the connections to the cold water pipe inside the building at the point of entrance. The grounding electrode for separately derived systems shall be approved for the application.

3.6 GROUNDING CONDUCTORS: The grounding conductors for both service ground electrodes shall be insulated or bare copper, sized in accordance with NEC 250-66, including the conductor for the made electrode. The conductors shall be continuous without joint or splice and shall be installed in conduit with the conduit bonded to the conductor at each end. Install the conductor to permit the shortest and the most direct path and terminate in the main service equipment on the common ground point. Equipment grounding conductors shall be green insulated conductors equivalent to the insulation on the associated phase conductor, but not less than Type TW. The equipment grounding conductor or straps shall be sized in accordance with NEC. Where one feeder serves a series of panelboards of transformers the equipment grounding conductor shall be continuous without splices. Grounding conductors shall not be installed through metal sheathed holes. All connections shall be available for inspection and maintenance.

3.7 GROUND CONNECTIONS: Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal it shall be painted or touched up with "Galvanoz", or equal.

3.8 TESTS

A. Remove all jumpers between the equipment ground busses and the service (neutral) ground busses in the main service panel and all separately derived systems. See Section 3.02.C.

B. For each grounding system, using an ohm-meter, measure the resistance between the two ground busses at the panel where the jumper was installed. The resistance shall be greater than 10 megohms.

C. Re-connect the equipment and service bus jumpers on all systems. See Section 3.02.C.

D. For each grounding system, using an ohm-meter, measure the resistance between the two ground busses at the panel farthest away (electrically) from the panel where the jumper was installed. The resistance shall be less than 5 ohms.

E. Submit a written report to the Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Engineer.

F. Test resistance from grounding electrode system to ground using ohm-meter.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.

2. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

A. HID: High-intensity discharge.

B. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaires and accessories.

3. Details of installation and construction.

4. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

5. Photoelectric relays.

6. Ballasts, including energy-efficiency data.

7. Lamps, including life, output, and energy-efficiency data.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

D. Warranty.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: One complete replacement set.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: Furnish at least one of each type.
3. Ballasts: Furnish at least two of each type.

PART 2 PRODUCTS

2.1 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Exterior fixtures shall comply with the New Mexico Night Sky Ordinance.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather-and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel, SS 316 or better.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat-and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and tested luminaire before shipping.

2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Adjustable window slide for adjusting on-off set points.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures 0 deg F (minus 18 deg C) and higher.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.

2. Sound Rating: A.

3. Electronic.

4. Total Harmonic Distortion Rating: Less than 10 percent.

5. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F (minus 18 deg C) and higher.

D. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features, unless otherwise indicated:

— Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.

— Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).

— Normal Ambient Operating Temperature: 104 deg F (40 deg C).

— Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

— Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

— 5 HID LAMPS

C. High-Pressure Sodium Lamps: ANSI C78.42, average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

PART 3 -EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to structural supports.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards

END OF SECTION

SECTION 26 60 10

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions, Supplementary General Conditions (if any) and General Requirements apply to the work specified in this section.

1.2 REQUIREMENTS: Comply with Underwriters Laboratories. Inc. UL 96A, and NFPA Standard #78.

PART 2 PRODUCTS

2.1 GENERAL: All materials for the lightning protection system shall be suitable for a copper-bronze system.

2.2 AIR TERMINAL RODS: Air terminal rods shall be 24 inches in height and shall have a tapered point. The rod shall be 1/2 inch minimum diameter below the point and shall be solid copper.

2.3 CONNECTORS: All clamps used in connecting conductors to each other and to air terminals shall be made of high conductivity copper or bronze alloy suitable for copper-copper or copper-bronze joints as the cast may be, and drawn tight with bolts or capscrews of similar metal clamps. Bolts or capscrews shall be of sufficient cross section that there shall be no distortion or breaking under any stress to which they might be subjected under ordinary usage.

2.4 CONDUCTORS: Counterpoise conductor below grade shall be bare stranded copper lightning protection and grounding conductor weighing not less than 420 pounds per thousand feet. The size of any wire in the cable shall be not less than .0689". Roof conductors shall be bare stranded copper lightning protection conductor weighing not less than 320 pounds per thousand feet, 24 strand, 14 gauge. Down lead conductors shall be bare stranded copper lightning protection conductor weighing not less than 320 pounds per thousand feet, 24 strand, 14 gauge.

2.5 GROUND RODS: Shall be one inch round and ten feet long, copper weld with top of the rod three feet minimum below grade. If copper can be seen from offsite it must be masked, capped, or disguised.

PART 3 EXECUTION

3.1 INSTALLATION: The installation shall be accomplished by the manufacturers installing contractor of the LPI, working under the direct supervision of the manufacturer. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof including all air terminals, splicers, and bonds with cable downleads routed concealed either directly in the building construction or in 1" PVC conduit to ground. Downlead cables shall not be brought directly through the roof. Through-roof connectors with solid rods or conduit through approved flashings shall be utilized for this purpose. Copper equipment shall not be connected to aluminum surfaces except by means of an approved bimetal transition fittings.

3.2 DRAWINGS: Shop drawings and plans for the system installation shall be approved by the Engineer before the cutting, fabricating, assembling, finishing, delivering or installation of any materials specified herein.

3.3 COORDINATION: The installer will work with other trades to insure a correct, neat, and unobtrusive installation. The lightning protection installer shall assure a sound bond to the main water service and interconnection with other building ground systems, including both telephone and electrical. All final flashing and sealing of lightning protection system roof penetrations shall be furnished and installed by the roofing contractor in compliance with the roofing system in use. A copy of the lightning protection system shop drawings shall be forwarded by the architect to the roof contractor for coordination purposes.

3.4 WORKMANSHIP: The installation shall comply with the applicable codes. All materials shall be new. Defective equipment and equipment damaged in the course of installation or tests shall be replaced or repaired in a manner meeting the approval of the Architect.

3.5 UNDERWRITERS LABORATORIES, INC. CERTIFICATION: The lightning protection system extension shall receive the Underwriters Laboratories Master Label. The master label shall be evidence that the installation of the lightning protection system has been made by an installer accredited by a manufacturer of listed lightning protection materials, that materials used are subject to factory inspection and are labeled and that the installation will require a field inspection program by UL with a report of inspection to the Owner, covering proper installation of the labeled materials according to UL requirements. Coordinate all facets of the extension to maintain master label for existing system and to provide a complete master labeled system for the entire complex. The contractor shall also submit copies of as-built shop drawings with LPI Form LPI-1-R91 to finalize the LPI Certified System Application with a copy of the test results.

3.6 AIR TERMINAL RODS: Shall be securely connected to and made electrically continuous with the roof conductors. Air terminals shall extend above the roof to which they are attached. Where practicable all air terminals shall be provided with at least two paths to ground.

3.7 ROOF CONDUCTORS: Shall be connected to all metal parts of the roof. Sharp turns in conductors shall be avoided. Bends shall have a radius of eight inches or more and shall not turn more than 90 degrees. Roof conductors shall be connected to form a closed loop and connect all air terminals together. Connections to air terminals shall be made with screwed or bolted clamps.

3.8 DOWN CONDUCTORS: Shall be electrically continuous from all terminals or roof conductors to the grounding system. Down conductors shall be concealed and shall be as widely separated as possible. All connections to down conductors shall be made with screwed or bolted clamps.

3.9 TESTS: After the installation of the lightning protection and static grounding system is completed and at such time as the Architect may direct, the Contractor shall provide a UL field inspector to conduct an operating test, as specified by the manufacturer, for approval. The Contractor shall furnish all instruments and personnel required for the test and it shall be performed in the presence of the Architect and Owner. Loose connections, inadequate ground or improper workmanship found by such tests shall be replaced or corrected at the Contractor's expense and the system retested until conditions are satisfactory. A report on the test shall be provided to the Owner.

3.10 Connections shall be made in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors hardware, conductors and connections methods so metal in direct contact will be galvanic ally compatible.

END OF SECTION

SECTION 27 43 30

SCADA TELEMETRY SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Navajo Area Indian Health Service Technical Provisions for Programmable Logic Motor Control and Tank Control Panels, Version 4.0, or latest version.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Section, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. SCADA PLC System and components.

1.3 DEFINITIONS

FCC:	Federal Communications Commission.
HMI:	Human Machine Interface.
MHz:	Megahertz.
NECA:	National Electrical Contractors Association.
NEMA:	National Electrical Manufacturers Association.
NFPA:	National Fire Protection Association.
NTUA:	Navajo Tribal Utility Authority, end-user for microwave radio system.
PLC:	Programmable Logic Controller.
RTU:	Remote Terminal Unit.
SCADA:	Supervisory Control and Data Acquisition.

1.4 SYSTEM DESCRIPTION

A. There are four (4) sites that need to be connected with NTUA’s existing SCADA network.

1. Reach 10.1 Surge Tank site
2. Pumping Plant 12 (PP12) site
3. Pumping Plant 13 (PP13) site
4. Nahodishgish Tank site

B. All SCADA equipment and programming shall comply with the Navajo Area Indian Health Service Technical Provisions for Programmable Logic Motor Control and Tank Control Panels, Version 4.0, or latest version. No substitutions will be allowed.

C. The contractor shall purchase, construct, energize, and program the equipment for four (4) new SCADA sites and establish communications with the existing NTUA SCADA network,

including control panels PLC, radios, and/or connection to optical fiber line, outdoor/indoor enclosure, antennas, and AC electrical equipment.

1. Reach 10.1 Surge Tank Site:
    a. The Reach 10.1 Surge Tank site will communicate with the NTUA SCADA network via optical fiber.
    b. SCADA equipment and PLC will be located inside the Reach 10.1 Surge Tank building.
    c. The PLC shall be able to send and receive I/O's to and from the existing NTUA SCADA network including controls, pertinent information including differential pressure transmitter readings, SCADA health, power supply status, surge tank level, and alarms.
2. Pumping Plant 12 Site:
    a. The PP12 site will communicate with PP13 and Standing Rock 1 Tank site through the NTUA SCADA network via optical fiber.
    b. SCADA equipment and PLC will be located inside the PP12 building.
    c. The PLC shall be able to send and receive I/O's to and from the existing NTUA SCADA network, PP13, and Standing Rock Tank 1 including controls, pertinent information including flowrates, pump data, pressure transmitter readings, SCADA health, power supply status, surge tank level, and alarms.
    d. PP12 will monitor regulating tank levels at PP13 to enable/disable it based on PP13 Regulating Tank's level.
3. Pumping Plant 13 Site:
    a. The PP13 site will communicate with the BBN9 Nahodishgish Regulating Tanks site via a combination of Fiber Optic and Licensed Radio. PP13 will also have a licensed radio to Standing Rock Tank 2/3.
    b. PP13 will communicate with PP14 and Standing Rock 1 Tank Site though NTUA's SCADA network via optical fiber. Through NTUA's fiber optic SCADA network, PP14 will relay Nahodishgish Tank pressure transmitter readings to PP13. PP13 will enable/disable it based on Nahodishgish Regulating Tanks level.
    c. PP13 will have a licensed radio link to the Standing Rock Tank 2/3 site. This communication will facilitate operation of BBN9 Reach 10.2.1. Standing Rock Tanks 2/3 pressure transmitter readings shall be communicated via radio to PP13, and PP13 will relay them via NTUA's fiber optic SCADA network to the booster pump at Standing Rock Tank 1 to enable/disable it based on Standing Rock Tank 2/3's level.
    d. SCADA equipment and PLCs will be located inside the PP13 building.
    e. The PLC shall be able to send and receive I/O's to and from the existing NTUA SCADA network including controls, pertinent information including flowrates, pump data, pressure transmitter readings, SCADA health, power supply status, surge tank level, and alarms.
4. Nahodishgish Tank Site:

a. The Nahodishgish Tank site will have a licensed radio link at the chlorinator to communicate with the NTUA SCADA Network via PP14. NTUA's fiber optic line does not go to the Nahodishgish Tank site and a licensed radio link to the PP14 site is required to relay Nahodishgish Tank site data.

b. SCADA equipment and PLCs will be located inside the chlorination building at the Nahodishgish Tank site.

c. The PLC shall be able to both send and receive I/O's, to and from the existing NTUA SCADA network including controls, and pertinent information including pressure transmitter readings, chlorine levels, flowrates, SCADA health, power supply status, surge tank level, and alarms.

5. All new radio systems for this project will be licensed radios.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for fiber optic and radio telemetry equipment.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add testing record of each piece of adjustable equipment, listing name of person testing and date of test.

D. Source quality-control test reports on coaxial cable sweep tests.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For radios, include operation and maintenance manuals. In addition to items specified in Section 01 00 00 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

2. Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments where installed.

B. Environmental Conditions: Capable of withstanding the wind, relative humidity and temperature conditions for specific equipment specified in Part 2.

1.8 COORDINATION

A. Coordinate size and location of raceway system, and provisions for electrical power to equipment of this Section.

B. Coordinate Work of this Section with requirements of NTUA.

C. Coordinate installation of equipment supports and wall penetrations.

PART 2 PRODUCTS

2.1 All products and materials required to provide SCADA communications shall comply with Navajo Area Indian Health Service Technical Provisions for Programmable Logic Motor Control and Tank Control Panels, Version 4.0.

2.2 OPTICAL FIBER

A. Single Mode Optical Fiber

B. All connectors shall be compatible with Corning SMF 28, or equivalent type optical fiber.

C. Nominal Fiber Performance

1. Max. Attenuation at 1310 nm individual fiber: 0.35 dB/km

2. Max. Attenuation at 1550 nm individual fiber: 0.22 dB/km

3. Chromatic Dispersion Maximum Individual Fiber: < 0.2 ps/km-1/2 – maximum value after H2 aging

D. Nominal Fiber Dimensions

1. Cladding Diameter: 125 ± 0.7 μm

2. Protective Coating: 245 ± 5 μm

3. Core/Cladding Concentricity Error: ≤ 0.5 μm

4. Mode Field Diameter at 1310 nm: 9.2 ± 0.5 μm

5. Mode Field Diameter at 1550 nm: 10.4 ± 0.8 μm

PART 3 EXECUTION

3.1 GENERAL WIRING

A. Wiring Method: Install cables in raceways and as otherwise indicated.

B. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

C. Grounding: According to recommendations in IEEE 142 and IEEE 1100.

3.2 COAXIAL CABLE INSTALLATION

A. Cold-Weather Installation: Bring the cable to room temperature before de-reeling. Heat lamps may not be used for heating.

B. Cable shall not be installed in same raceway with power cable.

C. Coaxial cable shall not be spliced.

D. Outdoor connections shall be installed in enclosures meeting NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.

E. Do not exceed manufacturer's recommended minimum bending radiuses

F. Attach antenna lead-in cable to support structure at intervals not exceeding 3 feet.

G. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

H. Exposed Cable: Install parallel to building lines, follow surface contours, and support cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables.

I. Cable Support: Install supports at intervals recommended in writing by cable manufacturer. Install supports within 6 inches of connector so no weight of cable is carried by connector. Use no staples or wire ties, pull tie-wrap snug, and do not over tighten.

3.3 ANTENNA INSTALLATION

A. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space. Parts that require periodic service or maintenance shall be readily accessible.

B. Align antenna elements to achieve maximum signal level and quality.

C. Grounding: As a minimum, comply with NFPA 780, "Installation of Lightning Protection Systems."

D. Antenna Cable Entrance: Use entrance fittings, seal, and waterproof penetrations of the building envelope.

3.4 FIELD QUALITY CONTROL

A. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

B. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Replace malfunctioning or damaged items. Retest until satisfactory performance and conditions are achieved:

C. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

D. Operational Tests: Perform operational system tests to verify that system complies with Specifications.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing surface debris.
2. Removing designated paving, curbs, and other obstructions.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Excavating topsoil.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 18 - Rock Removal.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of the New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Conform to applicable State of New Mexico code for environmental requirements, disposal of debris, burning debris on site, use of herbicides.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area and/or salvage area for placing removed materials.

3.2 PREPARATION

A. Call New Mexico "One Call" at 811 and/or local utility companies at least three (3) working days before performing Work.

1. Request that underground utilities be located and marked within and surrounding construction areas.

B. Contractor shall not work in any area where the designated work area has not been staked by Owner's Surveyor. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

C. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 – Basic Requirements and the Drawings for site-specific requirements.

3.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees and shrubs within indicated areas. Remove stumps and surface rock.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site, as directed in field by Engineer.

B. Tree removal:

1. Trees larger than 3" in diameter shall be cut, de-limbed, and left in stacks on edge of ROW for public firewood gatherers. Place firewood such that the public may gather it without creating safety hazards or additional disturbance to the public, work site or the environment.
2. Trees smaller than 3" in diameter, slash, and brush shall either be chipped and spread on the ROW or hauled to appropriate disposal site. Chipped material shall be distributed so as not to interfere with successful re-vegetation efforts.
3. Tree stumps and other material that cannot be chipped or used by the public shall be hauled to an appropriate disposal facility.
4. Contractor shall abide by all conditions contained in BLM pipeline and site ROW stipulations contained in Appendix C, regardless of land ownership status.

C. Partially remove paving, curbs, and other obstructions as indicated on Drawings. Neatly saw cut edges at right angle to surface.

D. Remove abandoned utilities as directed by Owner and/or Engineer. Indicate removal termination point for underground utilities on Record Documents.

E. Continuously clean up and remove waste materials from site. Do not allow materials to accumulate on site.

F. The Engineer will indicate to the Contractor which obstructions are to be removed, disposed of, or salvaged, and will require special documentation.

G. All existing fences crossed by the Work, or are within the construction area, are to be removed and rebuilt to original condition or better. Fence materials resulting from such removal are to be stored or disposed of as directed by the Engineer. Fence materials suitable for reuse or salvage that are damaged, lost or destroyed due to the Contractor's negligence or carelessness are to be replaced at the Contractor's expense.

H. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

A. Excavate top 6 inches of topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials or vegetable matter for use in finish grading.

B. Do not excavate wet topsoil.

C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion. Stockpile material on impervious material and cover over with same material, until disposal.

D. Remove excess topsoil not intended for reuse, from site.

E. All equipment shall be properly maintained and with proper safety devices.

F. Contractor must maintain control of dust and minimize blowing debris.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating subsoil.

2. Cutting, grading, filling, rough contouring, and compacting site for site structures and building pads.

B. Related Sections:

1. Section 02 21 32 - Surveying

2. Section 31 10 00 - Site Clearing: Excavating topsoil.

3. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.

4. Section 31 23 18 - Rock Removal.

5. Section 31 23 23 - Backfill: General building area backfilling.

6. Section 33 11 13 - Public Water Transmission Systems: Pipeline Right-of-Way grading

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. The following payment concepts only apply when a corresponding item is included in the Bid Schedule. If no specific item is provided, then this work shall be considered incidental to any items which require grading.

B. Topsoil Fill:

1. Basis of Payment: Includes excavating existing soil, supplying soil materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

C. Subsoil Fill:

1. Basis of Payment: Includes excavating existing subsoil, supplying subsoil materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

D. Structural Fill:

1. Basis of Payment: Includes excavating existing subsoil, supplying structural fill materials, stockpiling, scarifying substrate surface, placing where required, and compacting.

1.3 REFERENCES

A. Subsurface data:

1. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-00908 Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.2 Pump Plant 12 McKinley County, New Mexico” dated December 1, 2020 and the corresponding “Addendum 1 – Increased Tank Size”, dated September 24, 2021. Refer to Exhibit A of the Contract Documents.

2. Report prepared by Geo-Test, entitled: "Geotechnical Engineering Services Report No. 1-00909 Navajo Gallup Water Supply Project BBN9 Reach 10.2 Pump Plant 13 McKinley County, New Mexico", dated December 1, 2020 and the corresponding "Addendum 1 – Increased Tank Size" dated September 24, 2021. Refer to Exhibit A of the Contract Documents.
3. Report prepared by Geo-Test, entitled: "Geotechnical Engineering Services Report No. 1-0912A Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.1 Surge Tank Relocation McKinley County, New Mexico" dated November 11, 2021. Refer to Exhibit A of the Contract Documents.
4. Report prepared by Geo-Test, entitled: "Geotechnical Engineering Services Report No. 1-11001A Beacon Bisti N9 Waterline Project Nahodishgish Tank Site McKinley County, New Mexico", dated December 14, 2021. Refer to Exhibit A of the Contract Documents.
5. "Soil and Rock Potholing" data, as prepared by Souder, Miller & Associates. Refer to Exhibit B of the Contract Documents.
6. Soil Chemical Analysis for NGWSP BBN9, as prepared by SMA.
7. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports referenced above and the Technical Specifications, the more stringent requirement shall apply.
8. Refer to Section 01 00 00 regarding Contractor's ability to rely on subsurface data provided by Owner.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
8. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
9. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
10. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).

11. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
12. ASTM D2434 - Standard Test Method for Permeability of Granular Soils Constant Head.
13. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
14. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
15. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
16. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
17. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
18. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
19. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
20. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
21. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
22. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
23. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
24. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
25. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
26. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
27. ASTM D5080 - Rapid Determination of Percent Compaction.
28. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Samples: Submit, in airtight containers, 20 lb sample of each type of fill to testing laboratory.

C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

B. Perform Work in accordance with New Mexico Standard Specifications for Public Works Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. As specified in Section 31 23 23 - Backfill.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Quality Requirements: Examination of existing conditions before starting work.

B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Call New Mexico “One Call” at 811 and/or local utility companies at least three (3) days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area, or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 and the Drawings for site-specific requirements.

C. Identify required lines, levels, contours, and datum.

D. Notify utility company to remove and relocate utilities.

E. Protect remaining utilities from damage.

F. Protect plant life, lawns, and other features remaining as portion of final landscaping.

G. Protect benchmarks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.

B. Do not excavate in rain or snow.

C. Do not excavate frozen materials.

D. Blasting is not allowed.

E. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

F. Remove excess subsoil not intended for reuse and dispose of in accordance with these Technical Specifications.

G. Benching Slopes: Horizontally bench existing slopes greater than 4:1 (H:V) to key placed fill material to slope to provide firm bearing.

1. Do not exceed maximum slope of 4:1 (H:V) unless otherwise noted on the Drawings or directed by the Engineer.

H. Stability: Replace damaged or displaced subsoil as specified for fill.

I. Notify Owner of any utility damage at once so emergency measures can be taken. The Contractor will pay for any required repairs.

J. Remove and exclude water, including storm water, groundwater, irrigation water, and/or other waters, from all excavations. Dewatering wells, well-points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level below the bottom of excavations. Water shall be removed and excluded until backfilling is complete and all field soils testing have been completed.

K. Excavation Below Fills and Embankments: The subgrade areas beneath embankments shall be excavated to remove not less than the top 1 foot of native material and, where such sub-grade is sloped, the native material shall be benched. After the required excavation or over-excavation has been completed, the top 12 inches of material shall be scarified and moisture added or material dried to optimum moisture and the exposed surface shall be proof rolled.

L. Excavation under areas to be paved shall extend to the bottom of the sub-base. After the required excavation has been completed, the area shall be scarified a minimum of 12 inches below the subgrade surface and recompacted prior to the placement of the sub-base aggregate and/or base course aggregate. The finished sub-grade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

M. Damage to existing or new facilities or work caused by the Contractor's operations shall be repaired at no additional cost to the Owner.

N. Material beyond prescribed lines which is loosened by the Contractor's operations shall be removed, replaced and/or compacted, as directed by the Engineer, at no additional cost to the Owner.

3.4 FILLING

A. See Technical Specification 31 23 23 – Backfill.

3.5 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:

1. The finished grade substantially conforms with the drawings, or any deviation therefrom is approved by the Engineer

a. Blend with natural terrain

b. Minimum slope: 2%

c. Maximum slope: 4:1 (H:V)

2. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set for in Technical Specification 31 23 23 - Backfill and the Drawings, and

3. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.6 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Determine compaction characteristics of materials in accordance with ASTM D698.

C. Classify soils in accordance with ASTM D2487.

D. Field moisture content measured as specified in Section 31 23 23 - Backfill.

E. Unit weight of in-place compacted material shall be measured as specified in Section 31 23 23 - Backfill.

F. Perform in place compaction tests as specified in Section 31 23 23 - Backfill.

3.8 CORRECTION OF SUB-STANDARD WORK

A. Section 31 23 23 – Backfill: Correction of Sub-Standard Work.

END OF SECTION

SECTION 31 23 17

TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities.
2. Sheeting and shoring.
3. Disposal of excavated material.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface
4. Section 31 23 18 - Rock Removal.
5. Section 31 23 23 - Backfill: General backfilling.
6. Section 33 11 13 - Public Water Transmission Systems.

1.2 REFERENCES

A. Subsurface data:

1. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-00908 Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.2 Pump Plant 12 McKinley County, New Mexico” dated December 1, 2020 and the corresponding “Addendum 1 – Increased Tank Size”, dated September 24, 2021. Refer to Exhibit A of the Contract Documents.
2. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-00909 Navajo Gallup Water Supply Project BBN9 Reach 10.2 Pump Plant 13 McKinley County, New Mexico”, dated December 1, 2020 and the corresponding “Addendum 1 – Increased Tank Size” dated September 24, 2021. Refer to Exhibit A of the Contract Documents.
3. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-0912A Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.1 Surge Tank Relocation McKinley County, New Mexico” dated November 11, 2021. Refer to Exhibit A of the Contract Documents.
4. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-11001A Beacon Bisti N9 Waterline Project Nahodishgish Tank Site McKinley County, New Mexico”, dated December 14, 2021. Refer to Exhibit A of the Contract Documents.
5. “Soil and Rock Potholing” data, as prepared by Souder, Miller & Associates. Refer to Exhibit B of the Contract Documents.

6. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports referenced above and the Technical Specifications, the more stringent requirement shall apply.
7. Refer to Section 01 00 00 regarding Contractor's ability to rely on subsurface data provided by Owner.

B. New Mexico Standard Specifications for Public Works Construction (NMSSPWC):

1. NMSSPWC Sections 701, 801 & 802 "Trenching, Excavation and Backfill".

C. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

D. American Society for Testing and Materials International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3).
8. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
9. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
11. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
12. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
13. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
14. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
15. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
16. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.

17. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
18. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
19. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
20. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
21. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
22. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
23. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
24. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
25. ASTM D5080 - Rapid Determination of Percent Compaction.
26. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported fill materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with applicable New Mexico, Navajo Nation and U.S. Bureau of Reclamation standards.

B. Perform Work in accordance with applicable OSHA trench safety standards.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Pipe Bedding and Embedment: As specified in Section 31 23 23 - Backfill.

B. Pipe Backfill: As specified in Section 31 23 23 - Backfill.

C. Structural Fill: As specified in Section 31 23 23 - Backfill.

D. Concrete: Structural concrete, as specified in Section 03 30 00, with minimum compressive strength of 4,000 psi at 28 days. Concrete for thrust blocking with minimum compressive strength of 3,000 psi at 28 days.

PART 3 EXECUTION

3.1 PREPARATION

A. Call New Mexico "One Call" at 811 and local utilities not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Contractor shall not work in any area where the designated work area has not been staked by Owner's Surveyor. Contractor shall be wholly liable for any damage caused by working in areas that have not been staked, or by encroaching outside the staked work area.

C. Notify Engineer at least five (5) working days prior to commencing work within 100 feet of any designated restricted area or culturally sensitive area, as shown on Plans. Do not commence work unless barricades are in place and/or archaeological monitor is present, as required. Refer to Section 01 00 00 – Basic Requirements and the Drawings for site-specific requirements.

D. Identify required lines, levels, contours, and datum locations.

E. Protect plant life, lawns and other features remaining as portion of final landscaping.

F. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

G. Maintain and protect above and below grade utilities indicated to remain.

H. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 LINES, GRADES AND DIMENSIONS

A. Excavate trench to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required based on field conditions.

2. Deviations from horizontal and vertical pipe line and grade by Contractor: Refer to Section 33 11 13 – Public Water Transmission Systems.

3. When bottom of trench is rocky, over-excavate and fill as specified in Section 31 23 23 – Backfill.

B. Excavate trench to minimum width as indicated on Drawings.

1. Increase trench width as required to meet required clearances between pipe and trench wall, to avoid voids in the haunch areas of the pipe and to meet embedment compaction requirements or minimum soil cement slurry layer thickness. Increased trench width, if needed to meet these requirements, shall be provided at no additional cost to the Owner.

3.3 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove to 6 inches of topsoil and stockpile separately. The stockpiled soil shall be free of organic material. This topsoil shall be spread on top of the reclaimed area after backfilling, prior to re-seeding.

C. Remove lumped subsoil, boulders, and rock to bottom of trench.

D. Rock removal requiring specialized equipment or procedures as defined in Section 31 23 18 - Rock Removal, will be identified, quantified and paid for in accordance with Section 31 23 18.

E. Allowable open trench: Trenches may be opened in advance of pipe placement and backfill operations under the following conditions:

1. Do not open more than ½ mile of trench at one time. Do not leave any section of trench open for more than 24 hours.

2. Do not leave any trench open at the end of the workday within 100 feet of any road, driveway parking lot or other trafficked area, whether said road or driveway is shown on the Drawings or not.

3. Do not block vehicular traffic or impede access to homes or businesses.

4. Temporary fences shall be required for all trenches left open when the Contractor is not working on-site. All required temporary fencing shall be provided at no additional cost to the Owner.

5. Provide security at open trenches to protect the public, livestock, wildlife and the environment.

6. Comply with all stipulations set forth by McKinley County, BIA Department of Transportation, the Navajo Nation, and other land-controlling agencies and owners of existing utility lines. These stipulations are provided Appendix C and Exhibit D.

7. Provide animal escape ramps and cross-overs in accordance with the ROW stipulations provided in Appendix C.

8. Contractor is solely responsible for safety of all open trenches and bears sole liability for any incidents or accidents arising from open trenches.

9. The Owner may further restrict the amount of open trench as needed due to safety, land use or environmental considerations.

F. Remove water or materials that interfere with Work. Remove groundwater by pumping to keep excavations dry.

G. Provide uniform and continuous bearing and support for bedding material and pipe.

H. Do not interfere with 45 degree bearing splay of foundations. Any excavation in this area shall be backfilled and compacted using the same materials and methods as structural fill for new buildings. Refer to Section 31 23 23.

I. Slope or shore trench as needed to meet safety requirements. When sidewalls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered. Backfill and compact to reach specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to specified or directed line and grade. Refer to specifications for overexcavation backfill, as set forth in Section 31 23 23.

L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

M. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

N. Remove excess subsoil not intended for reuse from site.

O. Do not excavate in the rain or snow without approval from the Engineer.

P. Do not excavate in frozen materials without approval from the Engineer.

Q. Blasting is not allowed.

3.4 ADDITIONAL EXCAVATION

A. Perform additional excavation in trench bottom for pipe foundations as show on drawings and other additional excavations beyond specified lines as directed by the Engineer.

3.5 OVEREXCAVATION

A. When foundation material is over-excavated beyond specified or directed lines, fill the over-excavation with embedment or bedding material and compact in accordance with Section 31 23 23 - Backfill.

B. If foundation material is over-excavated by being disturbed or loosened during excavation, compact material in place or remove and replace with embedment or bedding material as determined by the Engineer and compact in accordance with Section 31 23 23 - Backfill.

3.6 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work. If the Engineer orders the sheeting to be left in place for the protection of the work, a payment will be allowed only for the actual cost of the timber left in place.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.7 BACKFILLING OF TRENCHES

A. See Section 31 23 23 – Backfill for general backfill requirements, as well as trench backfill, bedding and embedment requirements around pipelines.

3.8 DISPOSAL OF EXCAVATED MATERIALS

A. Excess excavated material or excavated material not suitable for backfill may be disposed of on-site, provided that:

1. The finished grade substantially conforms with the drawings, or any deviation therefrom is approved by the Engineer

a. Blend with natural terrain

b. Minimum slope: 2%

c. Maximum slope: 4:1, unless otherwise noted on Drawings

d. All excess excavated material spread on the right-of-way is compacted to the same specifications as final backfill, as set forth in Section 31 23 23 - Backfill and the Drawings, and

2. All on-site disposal of material is approved by the Engineer.

B. Do not dispose of waste material by dumping from tops of slopes.

C. Do not dispose of excess material within 15 feet of any wash, drainage or waterway.

D. Re-seed waste material areas in accordance with Section 32 92 19 - Seeding.

3.9 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

3.10 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Determine compaction characteristics of materials in accordance with ASTM D698.

C. Classify soils in accordance with ASTM D2487.

D. Field moisture content measured as specified in Section 31 23 23 - Backfill.

E. Unit weight of in-place compacted material shall be measured as specified in Section 31 23 23 - Backfill.

F. Perform in place compaction tests as specified in Section 31 23 23 - Backfill.

G. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to the Owner.

3.11 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting installed construction.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 23 18

ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing identified and discovered rock during excavation.

B. Related Sections:

1. Section 31 23 17 - Trenching: Trenching and backfilling for utilities.
2. Section 31 23 23 - Backfill: Backfill materials.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Trench Rock Removal:

1. Basis of Measurement:

a. By vertical linear foot (VLF) of trench excavation. Each VLF is measured as horizontal linear foot of trench multiplied by the depth of excavated rock. The depth of the excavated rock may be less than the total trench depth. The width of trench is not a factor in the VLF calculation.

2. Basis of Payment:

a. Includes preparation of rock for removal, mechanical disintegration of rock, removal from position, loading and removing from trench.

b. Payment will not be made for over-excavated work beyond the required bedding depth below invert elevation of pipe as shown on Drawings, nor for replacement materials.

c. If native trench rock is processed and used as pipe bedding or backfill material, the cost of such processing will be considered incidental to the cost of trench rock removal.

d. If trench rock is hauled away from site and replaced with imported material, the costs of rock hauling and disposal, as well as the costs of obtaining and hauling imported fill material will be considered incidental to the cost of trench rock removal.

e. The cost of placing and compacting embedment and backfill material, regardless of whether it is native or imported, will be considered incidental to pipeline installation.

3. Contractor shall notify Engineer prior to commencement of rock removal work when rock is encountered and specialized equipment will be required, and await approval from Engineer before proceeding.

4. Contractor and Engineer must agree on rock quantity at the end of each day that such work was completed, and both parties must sign off on the quantity on the corresponding Engineer's daily field report.

5. Pot holing data is included in Exhibit B to the Contract Documents package. This data is provided for informational purposes only and will not be used as a basis for payment. Final quantities will be determined in the field during the construction process, in coordination with the Engineer.

1.3 DEFINITIONS

A. Rock: Solid mineral material of size that cannot be removed with conventional equipment such as a track excavator or chain-driven trencher (excluding rock saw).

B. For trench excavation, a 235C Caterpillar excavator with a medium stick and a rock ripping bucket, or equivalent equipment, is considered conventional equipment, if it can excavate at a production rate of at least 30 bank cubic yards per hour.

C. If material cannot be excavated by conventional equipment, the Engineer must be immediately notified. The Contractor shall provide performance tests of the specified conventional or equivalent equipment. If the Engineer confirms in writing that the specified conventional equipment cannot perform at the production rates specified, the excavation shall be considered rock excavation.

1.4 SUBMITTALS

A. Submit type of equipment to be used for rock removal and/or processing.

B. If processed native rock is to be used for embedment and backfill, submit sieve analyses and other geotechnical data on the processed material, as required in field by Engineer.

1. Laboratory costs associated with such testing shall be reimbursable under project testing allowance. Other costs, such as sample collection and transport, are not covered under the allowance.

1.5 SCHEDULING

A. Section 01 00 00 - Administrative Requirements: Coordination.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination.

B. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical methods.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings.

D. For utility trenches, excavate to below invert elevation of pipe as shown on Drawings to ensure adequate bedding below pipe, and provide trench width as shown on Drawings to allow for proper embedment compaction or soil cement placement on sides of pipe. Exceptions to minimum trench width will be considered by Engineer if Contractor can demonstrate proper bedding and compaction are provided.

E. Disposal of excavated materials: Removed materials may be disposed of on-site, provided all criteria under Section 31 23 17 – Trenching, Article 3.8, are met.

3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

A. Not allowed.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Request visual inspection of foundation bearing surfaces by Engineer before installing subsequent work.

END OF SECTION

SECTION 31 23 23

BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.
6. Pipe bedding material.

B. Related Sections:

1. Section 02 21 32 - Surveying
2. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
3. Section 31 22 13 - Rough Grading: Site filling.
4. Section 31 23 17 - Trenching: Backfilling of utility trenches.
5. Section 31 23 18 - Rock Removal.
6. Section 31 23 25 – Controlled Low Strength Material.
7. Section 33 11 13 - Public Water Transmission Systems.

1.2 REFERENCES

A. Sub-surface Data:

1. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-00908 Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.2 Pump Plant 12 McKinley County, New Mexico” dated December 1, 2020 and the corresponding “Addendum 1 – Increased Tank Size”, dated September 24, 2021. Refer to Exhibit A of the Contract Documents.
2. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-00909 Navajo Gallup Water Supply Project BBN9 Reach 10.2 Pump Plant 13 McKinley County, New Mexico”, dated December 1, 2020 and the corresponding “Addendum 1” dated September 24, 2021. Refer to Exhibit A of the Contract Documents.
3. Report prepared by Geo-Test, entitled: “Geotechnical Engineering Services Report No. 1-0912A Navajo Gallup Water Supply Project Beacon Bisti N9 Reach 10.1 Surge Tank Relocation McKinley County, New Mexico” dated November 11, 2021. Refer to Exhibit A of the Contract Documents.

4. Report prepared by Geo-Test, entitled: "Geotechnical Engineering Services Report No. 1-11001A Beacon Bisti N9 Waterline Project Nahodishgish Tank Site McKinley County, New Mexico", dated December 14, 2021. Refer to Exhibit A of the Contract Documents.
5. "Soil and Rock Potholing" data, as prepared by Souder, Miller & Associates. Refer to Exhibit B of the Contract Documents.
6. Note that in the event of any discrepancy or difference in requirements between the geotechnical reports referenced above and the Technical Specifications, the more stringent requirement shall apply.
7. Refer to Section 01 00 00 regarding Contractor's ability to rely on subsurface data provided by Owner.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. ASTM International:

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse ‘‘Aggregates.
2. ASTM D422 - Particle -Size Analysis of Soils.
3. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
5. ASTM D1140 - Amount of Material in Soils Finer than the No. 200 Sieve.
6. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
7. ASTM D1633 - Test Method for Compressive Strength of Molded Soil - Cement Cylinders.
8. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
9. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
10. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
11. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedure).
12. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
13. ASTM D2901 - Test Method for Cement Content of Freshly Mixed Soil Cement.
14. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
15. ASTM D4254 - Minimum Index Density and Unit Weight of Sols and Calculation of Relative Density.
16. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

17. ASTM D4564 - Density of Soil in Place by the Sleeve Method.
18. ASTM D4643 - Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating.
19. ASTM D4718 - Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
20. ASTM D4832 - Compressive Strength of Controlled Low Strength Material.
21. ASTM D4914 - Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit.
22. ASTM D4959 - Determination of Water (Moisture) Content of Soil by Direct Heating.
23. ASTM D5030 - Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit.
24. ASTM D5080 - Rapid Determination of Percent Compaction.
25. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

D. United States Bureau of Reclamation (USBR):

1. USBR EM - Earth Manual, Part 2, Third Edition (1990).
2. Procedure No. and Title:
    a. USBR EM 3900 - Standard Definitions of Terms and Symbols Relating to Soil Mechanics.
    b. USBR EM 5000 - Determining Unified Soil Classification (Laboratory Method).
    c. USBR EM 5005 - Determining Unified Soil Classification (Visual Method).
    d. USBR EM 5300 - Determining Moisture Content of Soil and Rock by the Oven Method.
    e. USBR EM 5315 - Determining Moisture Content by the Microwave Method.
    f. USBR EM 5325 - Performing Gradation Analysis of Gravel Size Fraction of Soils.
    g. USBR EM 5330 - Performing Gradation Analysis of Fines and Sand Size Fraction of Soils, Including Hydrometer Analysis.
    h. USBR EM 5335 - Performing Gradation Analysis of Soils Without Hydrometer.
    i. USBR EM 5350 - Determining the Liquid Limit of Soils by the One Point Method.
    j. USBR EM 5355 - Determining the Liquid Limit of Soils by the Three Point Method.
    k. USBR EM 5360 - Determining the Plastic Limit and Plasticity Index of Soils.

l. USBR EM 5500 - Performing Laboratory Compaction of Soils - 5.5 lb Rammer and 18-in Drop.

m. USBR EM 5525 - Determining the Minimum Index Unit Weight of Cohesionless Soils.

n. USBR EM 5530 - Determining the Maximum Index Unit Weight of Cohesionless Soils.

o. USBR EM 5605 - Determining the Permeability and Settlement of Soils Containing Gravel.

p. USBR EM 7205 - Determining Unit Weight of Soils In-Place by the Sand-Cone Method.

q. USBR EM 7215 - Determining Unit Weight of Soils In-Place by the Sleeve Method.

r. USBR EM 7220 - Determining Unit Weight of Soils In-Place by the Sand Replacement Method in a Test Pit.

s. USBR EM 7221 - Determining Unit Weight of Soils In-Place by the Water Replacement Method in a Test Pit.

t. USBR EM 7230 - Determining Unit Weight and Moisture Content of Soils In-Place - Nuclear Moisture - Density Gauge.

u. USBR EM 7240 - Performing Rapid Method of Construction Control.

v. USBR EM 7250 - Determination of Percent Relative Density.

w. USBR EM 7255 - Determining the Percent Compaction of Earthwork for Construction Control.

1.3 DEFINITIONS

A. Percentage Compaction – Ratio, expressed as percentage, of actual density of material compared with maximum dry density based on Standard Proctor (ASTM D698).

B. Optimum Moisture Content – Based on Standard Proctor (ASTM D698).

C. Unified Soil Classification System – Based on ASTM D2487.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. Submit samples and certified test documentation of all materials to be used.

C. Materials Source: Submit name of imported fill materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

E. Submit field soil test on material in place as backfill.

PART 2 PRODUCTS

2.1 NATIVE FILL MATERIAL

A. Native material may be used for bedding, embedment and/or backfill, provided that said material meets all specifications set forth in this section. The Contractor may screen or otherwise process the material on-site to meet the specifications.

B. No dedicated borrow area for fill material has been pre-determined for this project. Native material may be borrowed from within the designated right-of-way and hauled within the project area if needed, provided that

a. All borrow areas receive prior approval from the Engineer. Finished grades shall conform to the finished grades shown in the plans, or any deviations therefrom must receive prior approval by the Engineer.

b. Borrow areas do not encroach beyond the designated project right-of-way. Borrow areas shall not encroach on any protected culturally sensitive area.

c. All borrow areas are sloped and dressed to minimize erosion.

d. Adequate stormwater pollution prevention measures are installed and maintained during construction. Such controls must be approved by the Engineer.

e. All borrow areas are re-seeded upon completion of the project, in accordance with Technical Specification 32 92 19, and post-construction stormwater controls are installed with approval from the Engineer.

C. All costs incurred in removing, hauling or processing native material and reclaiming borrow sites shall be considered incidental and shall be borne by the Contractor at no additional expense to the Owner.

D. The Owner makes no guarantee that native materials meeting the fill and backfill material specifications contained herein are available within the project area.

2.2 IMPORTED FILL MATERIAL

A. If imported materials are required to meet the quantity requirements of the project, it will be provided at no additional expense to the Owner.

B. If imported materials are required to backfill trenches where rock has been removed and disposed of, the cost of the imported fill material shall be included in the Contractor's bid price for rock excavation and backfill. Refer to Section 31 23 18 – Rock Removal.

2.3 TYPES OF ACCEPTABLE FILL MATERIAL

A. Structural Fill: Structural fill for use as sub-foundation material under tanks, buildings and other structures shall be provided in accordance with the Geotechnical Report provided in Exhibit A of the Contract Documents.

B. Fill for Appurtenances: Fill under and around in-line valves and structures at the same elevation as the pipe shall comply with specifications for the corresponding type of fill under or around the pipe. Fill under and around appurtenances such as valves, vaults and other structures above the top of the pipe shall comply with specifications for initial backfill material.

C. Pipe Bedding and Embedment Material: The following types of material are acceptable for use as pipe bedding and embedment material:

1. Crushed Rock: Not more that 25% passing 3/8-inch sieve and not more than 12% fines. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

2. Clean Coarse-Grained Soils: Sands and gravels with 12% or less fines. Unified Soil Classification System designation GW, GP, SW, SP or any soil beginning with one of these symbols. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

3. Coarse-Grained Soils with Fines: Sands and gravels with more than 12% fines. Unified Soil Classification System designation GC, GM, SC, SM or any soil beginning with one of these symbols. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

4. Sandy or Gravelly Fine-Grained Soils: Fine-grained soils (LL<50) with medium to no plasticity and with 30% or more coarse-grained particles. Unified Soil Classification System designation CL, ML or CL-ML. Maximum particle size shall not exceed ½ inch for pipe bedding and ¾ inch for embedment.

5. Other: Other types of material may be considered only with prior written approval by the Engineer. The Contractor is advised that soil amendment and/or higher levels of compaction may be required if using other soil types. Any costs associated with use of other soil types shall be borne by the Contractor at no additional expense to the Owner.

D. Pipe Backfill Material:

1. Initial backfill: All material placed in the trench between the top of the embedment and 18 inches above the top of the pipe shall be free from clumps, organic material, frozen material, debris or rocks larger than ¾ inch.

2. Final backfill: All material placed in the trench more than18 inches above the top of the pipe shall be free from clumps, organic material, frozen material, debris or rocks larger than 3 inches.

E. Drainage Culvert Backfill Material:

1. All material placed in the trench for galvanized drainage culvert pipe bedding and backfill shall be acceptable fill material as listed previously, with the following additional requirements:

   a. Resistivity (as per AASHTO T 288) greater than 2000 ohm-cm.

   b. pH (as per AASHTO T289) greater than 6.0.

   c. Volcanic ash type material for backfill shall not be used.

F. Base Course: Refer to Technical Specification 32 11 23 – Aggregate Base Course and Gravel.

G. Soil Cement Slurry: Refer to Technical Specification 31 23 25 – Soil Cement Slurry.

H. All fill material shall be free of clumps, organic material, frozen material, ice, snow, debris or organic contaminants.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Coordination and project conditions.

B. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 8 inches.

D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 USE OF ACCEPTABLE MATERIALS

Fill and Backfill materials specified in Part 2 of this Section shall be used in accordance with the following provisions:

A. Over-excavation: Backfill to specified or directed lines using Embedment or Bedding material as specified above.

B. Bedding: Use Bedding material as specified above.

C. Embedment: Use embedment material as specified above.

D. Initial back fill: For backfilling between top of embedment (0.7 of pipe O.D.) and 18” above top of pipe, use initial backfill material as specified above.

E. Final backfill: For backfilling more than 18” above top of pipe, backfill as follows:

1. Outside of surfaced roads, driveways or parking areas: Use final backfill material as specified above.

2. Under surfaced or paved roads, driveways or parking areas: Use final backfill material as specified above, topped with base course as specified above. Apply base course to same thickness as existing driving surface, or 6 inches, whichever is greater. If paved, apply pavement patch to thickness equal to or greater than existing pavement.

F. Embankments: Use final backfill material as specified above, unless otherwise indicated on the Drawings.

G. Under buildings, tanks, slabs-on-grade and other structures: Use structural fill as specified above unless otherwise indicated on Drawings.

H. Soil Cement Slurry: At Contractor’s option and expense, soil cement slurry may be used in lieu of bedding, embedment, initial backfill and/or final backfill materials. Soil cement slurry, if used, shall be provided at no additional expense to the Owner, and conforming to Section 31 23 25 Controlled Low Strength Material.

3.4 BACKFILLING FOR STRUCTURES, SITE WORK AND APPURTENANCES

A. Refer to the Geotechnical Report in Exhibit A regarding any issues not specifically addressed in these Technical Specifications. In the event of any discrepancies or differences in requirements between the Geotechnical Report and the Technical Specifications, the more stringent requirement shall apply.

B. Backfill areas to lines and grades as indicated on the Drawings or as directed by the Engineer.

1. For demolition work, backfill to existing grade or finished grade as indicated on Drawings, or as directed by the Engineer.

C. Systematically backfill to allow maximum time for natural settlement.

D. Do not backfill over porous, wet or spongy subgrade surfaces. Do not place backfill if either the material or the surface on which it is to be placed is frozen.

E. Each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer.

F. Place material in continuous, uniform layers such that all spaces around rocks and clods are filled. Thickness of such layers shall be as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.

2. Structural Fill: Maximum 6 inches compacted depth.

3. Granular Fill: Maximum 6 inches compacted depth.

G. Employ placement method that does not disturb or damage other work.

H. Slope grade away from building minimum 4%, unless otherwise noted on the Drawings.

I. Make gradual grade changes. Blend slope into level areas.

J. Shape and drain embankments and excavations, maintain ditches and drains to provide drainage at all times. Protect graded areas against action of elements prior to acceptance of work, and reestablish grade where settlement or erosion occurs.

K. Bench hillside slopes or fills to key the embankment. Remove and re-compact a minimum of 12 inches normal to the slope of the hillside or fill as the embankment or fill is brought up in layers.

L. Spread stockpiled topsoil on areas to be reclaimed prior to re-seeding.

M. Remove surplus backfill materials from site in accordance with Technical Specification 31 22 13 – Rough Grading.

N. Leave fill material stockpile areas free of excess fill materials.

3.5 BACKFILLING OF TRENCHES

A. Place material in pipe trenches to lines and grades indicated on Drawings or as directed by Engineer.

B. Do not place material when either the material or the surface upon which it is to be placed upon are frozen.

C. When using select material for pipe bedding, place bedding material below bottom of pipe before pipe is laid. Grade bedding material parallel to bottom of pipe.

D. When using select material for pipe embedment:

1. Exercise care not to damage pipe or appurtenances when placing embedment material.

2. Ensure material is placed to equal height on both sides of pipe to avoid unequal loading and possible lateral displacement of the pipe. Elevation difference of embedment between each side of pipe shall not exceed 6 inches.

3. Place material in uniform layers.

4. Work material into pipe haunches to prevent voids and achieve specified compaction under the haunches.

E. When using soil cement slurry: See Technical Specification 31 23 25 – Controlled Low Strength Material.

F. If pipe laying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

G. When the bottom of the trench is rocky, the trench shall be overexcavated and backfilled by 4 inches prior to placing the bedding layer, as directed by the Engineer. Backfill of this overexcavation shall comply with the requirements for overexcavation backfill provided in these Technical Specifications.

H. When using crushed rock or gravel for embedment on stretches longer than 300 feet, install trench plugs composed on silty, non-plastic material at 300 ft intervals to prevent piping of trench water through the embedment.

3.6 COMPACTION

A. Do not place and compact soil under the following conditions:

1. Ambient air temperature below freezing.

2. Rain that creates puddles in clayey or silty materials.

3. Ice or snow pockets visible in material being placed.

B. Surface Preparation:

1. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified percent compaction, if necessary.

2. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing first layer of material to be compacted.

3. Do not place material to be compacted on frozen surface.

C. Compact material in trenches in layers having approximately the same top elevation on both sides of the pipeline to avoid unequal loading and displacement of the pipe.

D. Placement:

1. Place soil to be compacted in horizontal layers.

2. Blend materials as needed to ensure compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations and other imperfections.

E. Compaction Procedures:

1. Silty or Clayey Material:

   a. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers or other suitable compaction equipment.

   b. Uniformly distribute equipment passes.

   c. Compact in horizontal layers to compacted thickness of 6 inches or less.

2. Cohesionless Free-Draining Material: Compact in horizontal layers to maximum compacted thickness of:

   a. Tampers and rollers: 6 inches

   b. Crawler-type tractors, vibrating drum rollers, surface vibrators or similar equipment: 12 inches

   c. Saturation and internal vibration: Penetrating depth of vibrator.

3. When compacting pipe embedment material, exercise care not to damage the pipe or appurtenances with compaction equipment. Do not apply compaction equipment directly above the pipe.

4. Demonstration: Lift thicknesses may vary depending on equipment and methods. Field adjustments to the specified lift thicknesses may be allowed or required. Contractor shall demonstrate that proposed equipment and methods will meet required compaction for the proposed lift thickness.

5. Flooding and jetting is not allowed unless specifically approved by the Engineer.

F. Moisture Content:

1. Optimum moisture content for each soil type, whether native soil or imported material, shall be determined by the Standard Proctor method, ASTM D 698.

2. Moisture content during compaction shall be no more than 2 percentage points wet or dry of optimum moisture content.

3. Moisten or aerate material, as necessary, to provide specified moisture content. Add water to soil in increments that will permit moisture content to be uniform and homogenous through each layer after mixing.

4. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.

   a. If clayey soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in clods.

   b. Use of disks, harrows or rakes may be required to blend moisture prior to placement and compaction.

5. For cohesionless soils, add water as necessary during compaction, as these soils are free-draining.

G. Minimum Percent Compaction:

1. Contractor is advised that compaction requirements shall be strictly enforced. In the event that the contractor is unable to meet compaction requirements for pipe

embedment using select material, the Contractor shall have the option to use soil cement at no additional cost to the Owner.

2. Over-excavation – Backfill of overexcavation to specified or directed lines shall be compacted to same percent compaction as embedment material or undisturbed foundation material, whichever is greater. If the in-place compaction of the undisturbed foundation material is greater than 95%, the overexcavation backfill may be compacted to 95%.

3. Embedment – Compact pipe embedment material to percent compaction as indicated on Drawings for given soil classification, pipe wall thickness diameter ratio (DR) and depth of cover. For pipes 10" diameter or smaller no compaction is required. For trenches within driving surfaces of roads, driveways or parking areas (both paved and unpaved), compact to 95%.

4. Initial and Final Backfill –

   a. Compact backfill to 95% for trenches within:
      1) The driving surfaces or prisms of roads, driveways or parking areas (both paved and unpaved), within wash or gas line crossings, crossings under bar ditches, and crossings at "head cutting" areas.
      2) Around valve boxes, air valve vaults, flush valves and vault foundations.
      3) Against thrust blocks and horizontal and vertical ells.

   b. For trenches outside of roads, driveways, parking areas, gas line crossing, or wash crossings, compaction of the backfill is not required, provided soil is mounded above the trench.

5. Embankments – Compact to same requirements as Final Backfill.

6. Under buildings, tanks, slabs and other structures – Compact in accordance with Geotechnical reports provided in Exhibit A.

7. Site(s) – Compact all driving surfaces and fill slopes to 95%.

8. Note that all Percent Compaction values in these Technical Specifications and Drawings are based on Standard Proctor, ASTM D698.

H. Soil Cement Slurry may be used in trenches, at Contractor's option and expense, to replace bedding, embedment or backfill materials where it is not practical to reach minimum compaction requirements using select material.

1. If soil cement slurry is to be used in lieu of embedment material, soil cement slurry shall also replace the bedding material. Do not use soil cement slurry for embedment on top of select material bedding.

3.7 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling within Building Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.

D. Percent Compaction: Shall meet minimum required compaction as set forth in these Technical Specifications

E. Moisture Content: As set forth in these Technical Specifications.

3.8 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, Adjusting, and Balancing.

B. Classification of materials to determine adequacy for use as fill or backfill shall be performed in accordance with ASTM D2487 and designated based on the Unified Soil Classification System described therein.

C. Measurement of optimum moisture content and maximum dry density for each type of material to be compacted shall be determined using the Standard Proctor method, ASTM D698.

1. All references to “optimum moisture content” or “percent compaction” in these Technical Specifications and on the Drawings are based on Standard Proctor, ASTM D698.

2. While it may not be necessary to perform a separate Proctor test for every single compaction test location, it is necessary to perform this test for every type of material to be field tested. All material tested for compaction must correspond to a representative Proctor test.

3. Exhibit A to the Contract Documents contains the geotechnical report which includes in-situ soil moisture measurements and Standard Proctor test results (including optimal moisture content) from test holes at various locations along the pipeline. Contractor is advised that test holes reveal information about only a very small area, and sub-surface conditions between the test holes may vary. Contractor is wholly responsible for any assumptions made about sub-surface conditions between the test holes. Moreover, in-situ moisture content varies with time, and the Owner makes no representation that the in-situ moisture at the time the measurements were taken will be the same at the time of construction.

    a. Contractor shall perform Proctor tests on actual fill material (whether native or imported) and shall base determination of optimum moisture content and maximum density for compaction on the Contractor’s own tests.

4. Proctor tests upon which the Contractor bases determination of optimum moisture content and maximum density for calculation of percent compaction are subject to approval by the Engineer. The Engineer may require additional tests to ensure that Proctor tests are representative of the actual fill material being compacted.

D. Field moisture content shall be measured by one or more of the following methods, as determined by the Engineer:

1. ASTM D2216 (USBR EM 5300)

2. ASTM D6938 (USBR EM 7230), provided that corrections can be made of gage error for the specific soils tested. The moisture content of the total material may require adjustment for the control fraction in accordance with ASTM D4718 (USBR EM 7230, Method C).

3. ASTM D4959 or ASTM D4643 (USBR EM 5315), provided that the results have been correlated to ASTM D 2216 (USBR EM 5300) for the specific soil tested.

4. For silty or clayey soils containing more than 5% gravel: Results of water content corrected for oversized particle in accordance with ASTM D4718.

E. Unit weight of in-place compacted material shall be measured as follows:

1. Haunch area of pipe – By Drive Cylinder (ASTM D2937) or by Sand Cone (ASTM D1556 or USBR EM 7205), or as directed by the Engineer

2. Springline of pipe – By Sand Cone (ASTM D1556 or USBR EM 7205), or as directed by the Engineer

3. For cohesionless soils – By Sleeve Method (ASTM D4564 or USBR EM 7215), or as directed by the Engineer

4. Initial trench backfill – By Sand Cone (ASTM D1556 or USBR EM 7205) or by Nuclear Methods (ASTM D6938), as directed by the Engineer. Note that selection of density test will depend in part on distance from the pipe and potential for pipe interference with nuclear density measurements.

5. Final trench backfill – By Sand Cone (ASTM D1556 or USBR EM 7205) or by Nuclear Methods (ASTM D6938), as directed by the Engineer. Note that selection of density test will depend in part on distance from the pipe and potential for pipe interference with nuclear density measurements.

6. Fill outside of trenches, including embankments, structural fill and driving surfaces – By Nuclear Methods (ASTM D6938).

7. For silty or clayey soils containing more than 5% gravel: Results of unit weight corrected for oversized particle in accordance with ASTM D4718.

F. Percent compaction shall be determined by one of the following methods:

1. Comparison of in-place density of compacted material with maximum dry density of similar soil, as determined by Standard Proctor, ASTM D698.

2. Rapid Method: ASTM D5080 (USBR EM 7240)

G. Compaction testing frequency:

1. Minimum testing intervals shall be as follows:

a. One test per compaction crew per day

b. One test pit per 1000 LF of pipeline

c. One test per 500 CY of structural fill or one test per lift, whichever results in greater testing frequency

2. Greater testing frequency is typically required at the beginning of new work, new personnel, new compaction methods or new equipment.

3. Additional tests may be required for areas suspected of having incomplete compaction or improper moisture content, or surfaces that may have become torn up subsequent to compaction efforts, at the direction of the Engineer.

4. Additional tests may be required for any reason at the discretion of the Engineer.

H. Contractor Support

1. At the direction of the Engineer, the Contractor shall provide inspection pits to check for voids under the haunches of the pipe and test pits to perform density and compaction testing at the springline and haunch areas of the pipe or against structure foundations.

   a. All test and inspection pits shall comply with all relevant OSHA safety requirements.

   b. Contractor shall provide warning lights, flags and other safety devices as needed by testing personnel.

   c. Upon completion of testing, Contractor shall backfill pits to original fill and backfill requirements.

2. When density is being measured by Sand Cone, Contractor shall cease construction activity in the immediate vicinity of testing.

3. The cost of all work associated with excavating, protecting and backfilling inspection and test pits, including implementation of safety requirements and time delays, shall be incidental to the unit price of the applicable pay item being tested, and shall be provided at no additional cost to the Owner.

4. Laboratory fees only shall be reimbursed to the Contractor from the Materials Testing Allowance bid item in accordance with Section 01 00 00 - Basic Requirements: Testing and Inspection Allowances. Other costs associated with testing, such as excavations, providing access, safety, time delays, transportation and other costs shall be considered incidental to the work.

3.9 CORRECTION OF SUB-STANDARD WORK

A. All fill and backfill represented by tests that fail to meet compaction, moisture content, soil classification or other specifications shall be uncovered as needed, replaced as needed, re-compacted and re-tested until all specifications are met, at no additional expense to the Owner.

1. Elevations, lines and grades of replaced material, as well as of pipe and other structures resting against such material, shall be re-surveyed at the direction of the Engineer, at Contractor's sole expense. Contractor shall correct elevations, lines and grades as needed, at Contractor's sole expense.

B. The cost of failed tests shall not be reimbursed by the Owner from the testing allowance.

3.10 PROTECTION OF FINISHED WORK

A. Section 01 00 00 - Execution Requirements: Protecting Installed Construction.

B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 25

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Controlled Low Strength Material (CLSM) for:

a. Utility bedding.

b. Utility backfill.

B. Related Sections:

1. Section 31 23 17 - Trenching: Soil and aggregate backfill for utility trenches.

2. Section 31 23 23 - Backfill: Soil and aggregate backfill for structures.

1.2 BASIS OF MEASUREMENT AND PAYMENT

A. Controlled Low Strength Material (CLSM):

1. Measurement: Volume measured in place to lines, grades, and dimensions shown on drawings or established by the Engineer.

2. Payment: Shall be considered incidental to the price of the items embedded in the CLSM. No separate payment shall be made.

1.3 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318 - Building Code Requirements for Structural Concrete

B. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.

2. ASTM C40 - Organic Impurities in Fine Aggregates for Concrete.

3. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

4. ASTM C114 - Chemical Analysis of Hydraulic Cement.

5. ASTM C143/C143M - Slump of Hydraulic Cement Concrete.

6. ASTM C150 - Standard Specification for Portland Cement.

7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

8. ASTM C403/C403M - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.

9. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.

10. ASTM C595 - Blended Hydraulic Cements.

11. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
12. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
13. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete In Place By Nuclear Methods.
14. ASTM C1602/C1602M - Mixing Water Used in the Production of Hydraulic Cement Concrete.
15. ASTM D558 - Standard Test Methods for Moisture-Density Relations of Soil-Cement Mixtures.
16. ASTM D1558 - Moisture Content Penetration Resistance of Fine Grained Soils
17. ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils
18. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
19. ASTM D6024 - Ball Drop on Control Low Strength material (CLSM) to determine Suitability for Load Application
20. ASTM D6103 - Flow Consistency of Controlled Low Strength Material.

1.4 DEFINITIONS

A. The term “CLSM” is commonly used as an abbreviation for “Controlled Low Strength Material” in the contract documents.

1.5 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures: Requirements for submittals.

B. Approval Data for CLSM Produced Without Native Soil:

1. Mix Design: For each CLSM Mix:
    a. Mixture Proportions.
    b. Material Sources:
        1) Name and manufacturer of each cementitious material.
        2) Name of aggregate sources.
        3) Product name and manufacturer of admixtures to be used in mix.
        4) Government reserves right to require submission of samples of CLSM materials for testing before or during use in concrete.
    c. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:
        1) 10 to 30 passing 200 sieve
        2) 30 to 50 passing 200 sieve
    d. Physical properties:
        1) Trial mixtures:
            a) Results from trial batches made within past 6 months.
            b) Trial mix test results, three 6 inch diameter, 12 inch high cylinders. each at 7 days and 28 days

c) Average compressive strength of trial batch cylinders at specified design age.

e. Resubmit mix design for change in material source or type.

f. Cementitious materials manufacturer's certifications and test reports within last 6 months.

g. Aggregate test reports for gradation and plasticity, less than 6 months old.

h. Method to determine moisture and consistency of materials to maintain specified strengths. Provide testing frequency.

2. If Quality control test results show CLSM does not meet requirements, submit revised mix design.

C. Approval Data for CLSM Produced With Native Soil:

1. Submit Mix design for each material type:

a. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:
1) 10 to 30 percent passing 200 sieve.
2) 30 to 50 percent passing 200 sieve.

b. Physical properties:
1) Trial mixtures:
a) Results from trial batches made within past 6 months.
b) Trial mix test results, three 6 inch diameter, 12 inch high cylinders each at 7 days and 28 days.
c) Average compressive strength of trial batch cylinders at specified design age.

c. Resubmit mix design for change in material source or type.

d. Cementitious materials manufacturer's certifications and test reports within the last 6 months.

e. Material test reports for gradation and plasticity, less than 6 months old.

2. Soil processing and mixing equipment.

3. Foreman references.

4. Method to maintain specified strengths using native soils.

5. If quality control test results show CLSM does not meet specified requirements, submit revised mix design.

D. Quality Control Test Results:

1. Notify Resident Project Representative within 2 hours if testing does not meet specified requirements.

2. If Quality Control Test Results show CLSM does not meet specified requirements, submit a revised mix design.

E. Approval Data for method to prevent pipe flotation while placing CLSM.

1.6 DELIVERY, STORAGE AND HANDLING

A. For CLSM delivered from ready mix plants, furnish batch ticket with each batch of CLSM in accordance with ASTM C94. Deliver ticket to Resident Project Representative at jobsite prior to discharging material from the transport vehicle.

1.7 QUALIFICATIONS

A. References for foreman in charge of CLSM placement, if CLSM is produced with native soils: 3 projects within last 3 years.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

A. Cement and pozzolan shipments shall be accompanied by shipping documents containing:

1. Manufactures Certification that material meets requirements.
2. Type or class of material shipped.
3. Manufacturing locations and dates.
4. Lot (bin) number.
5. Date of shipment.
6. Quantity of material shipped.
7. Provide to Resident Project Representative.

B. Cementitious Materials Option:

1. Specified Portland cement plus 20 to 80 percent by weight of total cementitious (cement plus pozzolan) specified pozzolan, in accordance with ACI 318.

C. Portland Cement:

1. ASTM C150, Type II.
2. Meet equivalent alkalies requirements of ASTM C150 - Table 2.
3. Meet false-set requirements of ASTM C150 - Table 4.

D. Pozzolan:

1. ASTM C618, Class F, except:
   a. Sulfur trioxide for Class F, maximum: 4.0 percent.
   b. Loss on ignition, maximum: 2.5 percent.
   c. Test for effectiveness in controlling alkali-silica reaction under optional physical requirements in Table 2 of ASTM C618. Use low-alkali cement for test.
   d. Does not decrease sulfate resistance of concrete by use of pozzolan.

1) Demonstration pozzolan will have an "R" factor less than 2.5.

2) R = (C-5)/F

3) C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C114.

4) F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C114.

2.2 WATER

A. Water: ASTM C1602, including optional requirements of Table 2.

2.3 AGGREGATE

A. Aggregate: ASTM C33

1. Maximum particle size: 1-1/2 inches or 1/8 of open distance between pipe and trench wall, whichever is less.

2.4 SOIL

A. Soil producing a color darker than the standard color when tested in accordance with ASTMC40: Not allowed.

B. Plasticity: Non-plastic or low plasticity (P.I. less than 5) in accordance with ASTM D4318.

C. Gradation:

1. Passing U.S. Standard N0. 200 sieve by weight, maximum: 50 percent.

2. Passing U.S. Standard No. 100 sieve by weight, maximum: 70 percent.

3. Maximum particle size: 1/8 of open distance between pipe and trench wall or 3/8 inch, whichever is less.

D. Select or process soil so that particles remain in suspension, i.e. no segregation occurs, when CLSM is placed.

E. Clay balls:

1. Maximum percent, by weight of soil: 10 percent.

2. Maximum size: 3/8 inch.

2.5 MIX

A. Mixture of Aggregate or Soil, Cementitious Materials, Water, and Admixtures:

1. Cementitious material content: Percent by dry weight of aggregate or soil to obtain specified compressive strength.

2. Make trial mixes prior to placing CLSM to determine mixture adequacy.

a. Determine compressive strength in accordance with ASTM D4832.

b. Determine slump in accordance with ASTM C143.

B. Water content: Not to exceed that required to provide a mix that will flow and can be pumped.

C. 7-day compressive strength, ASTM D4832: Not less than 50 psi and not more than 150 psi.

D. Consistency:

1. Except, when stiffer mix required to prevent CLSM from flowing down trenches on a steep slope:

a. Slump, ASTM C143: 8 to 10 inches.

2.6 CLSM TEMPERATURE

A. CLSM temperature at time of placement: 50 degrees to 85 degrees F (10 to 30 degrees C).

PART 3 EXECUTION

3.1 BATCHING EQUIPMENT

A. Design and operation of mixers: CLSM, as discharged, is uniform in composition and consistency throughout each batch.

1. Adjust amount of water and aggregates batched for CLSM to compensate for variations in moisture content or grading of aggregates as they enter mixer.

2. Inform Engineer prior to and after adjustments in batching equipment and control instrumentation.

3. Equip truck mixer with dial or digital water meter accurate to within 1 percent of total mix water located between water supply and mixer.

4. Provide revolution counter which indicates total number of revolutions of drum per batch.

a. Visible from outside truck.

b. Reset to zero for each batch.

5. Attach metal plate attached in a prominent place on the mixer listing:

a. Manufacturer’s recommended drum capacity.

b. Mixing and agitating speeds in accordance with ASTM C94.

6. Initial Mixing: Not less than 70 revolutions and not more than 100 revolutions after ingredients are in the drum.

7. Mix 30 revolutions after addition of tempering water.

8. Mix 10 to 12 revolutions after a prolonged period of agitation.

9. Discharge CLSM before 300 drum revolutions

B. Manufacture and deliver in accordance with ASTM C94.

1. In addition to the requirements of ASTM C94, use a water meter approved by the Engineer to measure and record mix water for each batch.

C. Provide following information to Engineer:

1. Copy of current calibration of scales and water meters.
2. Mix water information.

3.2 TRIAL BATCH

A. Perform trial run with proposed equipment and material prior to placing CLSM.

1. Obtain Representative Sample of Material:

a. If native soil materials are used, mix material from top of trench to proposed invert.
1) Discard plastic material.

b. Test material for gradation, plasticity.

2. Test CLSM for slump and compressive strength.

a. Prepare and test three 6 by 12 inch cylinders for both 7 and 28 day according to ASTM D4832.

3.3 PREPARATION

A. Place pipe on soil pads or other approved compressible material such as extruded polystyrene foam insulation. Soil pads shall maintain horizontal and vertical alignment during backfilling operations.

1. Do not create point loads on the pipe.

a. Soil pads shall have a lower compressible strength than the surrounding CLSM.

3.4 PLACING

A. Notify Engineer at least 24 hours before batching CLSM. Include quantity of CLSM required for each daily placement.

B. Do not place CLSM during rain or on frozen ground.

C. Do not mix or place CLSM when ambient temperature is below 40 degrees F. When ambient temperature is 35 degrees F or above, CLSM may be placed when ambient temperature is rising with approval from Engineer.

D. Place CLSM to lines, grade, and dimensions shown on drawings.

1. Initially, place CLSM from one side of pipe. Where necessary, rod or vibrate CLSM so that CLSM flows under pipe and appears on other side.
2. Add CLSM to both sides of pipe and rod or vibrate until CLSM completely fills space between pipe and trench.
3. Ensure that CLSM flows freely from one side of the pipe to the other.
4. Do not disturb trench or allow foreign material to become entrained in the CLSM.

E. Do not allow the pipe to float or move.

1. The Engineer may limit the length of pipe that can be laid or embedded with CLSM in advance of backfilling operations to prevent flotation, or may require the contractor to place the CLSM in layers to prevent flotation or movement.
2. Restrain pipe to prevent flotation or movement during and after placement of CLSM.
3. Pipe that has floated or moved after surveying shall be re-surveyed at the direction of the Engineer to ensure compliance with specified lines and grades. contractor shall correct lines and grades, and pipe shall be re-surveyed after such correction, as needed. All re-surveying shall be done at contractors' sole expense.
4. Do not disturb pipe trench or allow foreign material to become mixed with CLSM.
5. Do not point load pipe.

F. Do not place backfill material over CLSM until CLSM has reached initial set.

1. As determined by ASTM D6024 (ball drop test) or ASTM D1558 in the presence of the Engineer.
2. Do not place greater than 10 feet of backfill over the pipe until the CLSM has a compressive strength of 50 pounds per square inch or greater.

3.5 CONTRACTOR FIELD QUALITY TESTING

A. Testing:

1. Independent testing laboratory shall perform sampling, testing, and reporting
2. If CLSM Contains Native Soils:
    a. Obtain and test soil samples for gradation and plasticity once every 14 days at a minimum or if a change in soil is visually noted.
        1) Test material 14 days ahead of placement from top of trench to proposed invert.
    b. During CLSM batching, provide an inspector from testing laboratory to monitor soil characteristics and operations.
        1) Modify material and or batching operations as recommended by testing laboratory.
        2) Notify Engineer within 24 hours of modifications.
3. Obtain samples and test to determine compressive strength in accordance with ASTM D4832 and slump in accordance with ASTM C143.
    a. Testing frequency:
        1) At least once for each shift when placing CLSM.
        2) Once every 100 cubic yards or,
        3) If consistency of materials change.
    b. Acceptance Criteria:
        1) 7 day compressive strength, ASTM D4832:
            a) Not less than 50psi and not more than 150 psi.
            b) 70 percent of test cylinders shall exceed 75 psi.
    c. Make adjustments to mixture to comply with strength requirements.

d. Stop work if specified requirements are not met.

3.6 FIELD QUALITY ASSURANCE

A. The contractor shall supply material samples to Engineer upon request for independent testing of compressive strength in accordance with ASTM D4832 and slump in accordance with ASTM C143.

3.7 PROTECTION

A. When subsequent lifts of CLSM are to be placed, maintain surface of CLSM in a moist condition by use of tarps or water mist until subsequent lift of CLSM is placed.

B. If backfill will not be placed over CLSM within 8 hours after initial set, place 6-inch minimum cover of moist backfill over CLSM. Maintain moisture in 6-inch soil cover until additional backfill is placed.

C. If ambient temperature is 50 degrees F or less, place 12-inch minimum additional cover of loose backfill over 6-inch moist backfill cover before end of workday. Do not allow CLSM to freeze.

END OF SECTION

SECTION 31 35 27

CABLE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cable concrete mats.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 03 30 00 Cast-In-Place Concrete.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Cable concrete mats:

1. Basis of Measurement: By square yard of cable concrete mat for horizontal surface only. Wastage will not be paid for. Area of turn-downs are not included in quantities on Drawings and Bid Form and shall be considered incidental to the Contractor's price.
2. Basis of Payment: Includes cable concrete mat, geotextile, preparation of surface, compaction, placing of cable concrete mats, cable clamps, clips, anchors, lifting bar rental, mobilization and delivery.

B. Bid items for cable concrete mats or other specific erosion control features that appear on the Bid Form apply only to features designed and directed by the Engineer. They do not include preparation of the Storm Water Pollution Prevention Plan (SWPPP) or implementation of any Best Management Practices (BMPs) stipulated therein. Separate bid items are provided for preparation and implementation of the SWPPP. Contractor is wholly responsible to prepare and implement the SWPPP to the satisfaction of relevant governmental authorities for the prices given under the SWPPP bid items.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Cable concrete materials.

1.4 QUALITY ASSURANCE

A. General:

1. Tests on concrete will be performed in accordance with all requirements of applicable ASTM standards for such tests, including but not limited to obtaining samples, temperature, slump, air entrainment, making and curing specimens, breaking concrete cylinders, and other as may be applicable.

2. The cost of all laboratory tests on cement, aggregates, and concrete, for the development of the mix design, will be borne by the Contractor. The laboratory must meet or exceed the requirements of ASTM C1077.

3. Test cylinders will be prepared one (1) test each day of placement for each mixture for the first 50 or less cubic yards and one (1) test for each additional 100 cubic yards of concrete.

B. Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as indicated above to ensure continued compliance with these specifications. Each set of test specimens will be a minimum of 5 cylinders.

2. Compression test specimens for concrete shall be made in accordance with ASTM C31. Specimens shall be 6-inch diameter by 12-inch high cylinders.

3. Compression tests shall be performed in accordance with ASTM C39. One test cylinder will be tested at 7 days, and 2 at 28 days. The remaining cylinders will be held to verify test results, if needed.

4. Compression testing will be paid for by the Owner.

C. Evaluation and Acceptance of Concrete:

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, and as specified herein.

2. All concrete that fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.

3. Concrete delivered to the site that does not meet the requirements as herein specified may be rejected.

D. Visual Inspection:

1. A visual inspection of the mats shall be completed.

2. All mats shall be sound and free of defects that would interfere with the proper placing of the mats or impair the strength or performance of the construction.

3. Pin holes on the surface of the mats resulting from entrapped air in the wet cast procedure, surface cracks and any other incidental imperfections from the usual methods of manufacturing including surface chipping from handling the mats on the job site and in shipment and delivery, shall not be deemed grounds for rejection.

4. Cable concrete that does not meet the requirements as herein specified may be rejected.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete:

1. Minimum 28-day compressive strength: 4,000 psi.
2. Minimum density: 140 lbs/cf
3. Air entrainment- all concrete shall contain 5.5% +/- 1.5% entrained air of evenly dispersed air bubbles at the time of placement.
4. Concrete Materials: Refer to Technical Specification 03 30 00 – Cast-In-Place Concrete.
5. Blocks shall be 15.5” square at the base and 11.5” square at the top face (truncated pyramid shape), and have a height of 5.5”.
6. The blocks shall be spaced 0.5” at the base.
7. Weight: 52 lbs per square foot

B. Geotextile Fabric:

1. 8 oz. per square yard.
2. Needle punched non-woven geotextile fabric.
3. Shall be attached to the bottom of the articulated concrete mat during production.
4. An overlap of 2’ to 3’ shall be incorporated on three sides of the mat. The overlap shall provide an area for the adjoining mats to be placed upon and prevent undermining of the erosion control system.

C. Cables:

1. Cables shall be made of stainless steel aircraft cables of type 304, shall be 1 x 19 construction, with 3/16” diameter, and 4,700 lbs breaking strength.
2. Cables shall be integral (poured into) to the concrete block, and shall traverse through each block in both longitudinal and lateral directions of the mat system.

D. Clamps:

1. Stainless steel clamps shall be used to secure loops of adjoining cable concrete mats.
    a. The standard placement of clamps shall be placed on 4’ centers interlocking adjoining mats together.
    b. The clamps are required only in applications exceeding 10’ per section. In slope applications greater than 2 to 1 where the mats are placed end to end, clips shall be placed on 4’ centers interlocking adjoining mats together.
2. Position cable clamps as close to the base of the concrete block by sliding cable clamp down to the adjacent loops before tightening securely.
3. Stainless steel Type 304 shall be used.

PART 3 EXECUTION

3.1 INSTALLATION

A. Placement shall be in accordance with Manufacturer's recommendations.

B. Do not place cable concrete mats over spongy subgrade surfaces.

C. Surface erosion control locations, dimensions, and quantities shown on Drawings are approximations only, and are subject to change based on finished grade. Final quantities, dimensions, and locations of cable concrete mats to be determined in field by Engineer after installation of pipeline and related facilities.

D. Prepared areas shall be graded to a smooth plane finish. Any roots, debris and stones must be removed and regarded. The mats shall be laid in such a manner to produce a smooth plane surface.

E. The gaps between each cable concrete mat shall not be greater than 1".

F. For at-grade installations, where approved by Engineer, the upstream and downstream edges of the mat system shall be keyed into the ground at a 45°angle for a length of 2 block rows on both the upstream and downstream edges, or as shown on Drawings.

G. For buried installations at wash crossings, the upstream edge shall be turned down vertically for 2 block rows, and the downstream edge shall be turned down vertically for 1 block row, or as shown on Drawings.

3.2 FIELD QUALITY CONTROL

A. Cracks exceeding 0.25 inches (0.635 cm) in width and/or 1.0 inch (2.54 cm) in depth, shall be deemed grounds for rejection.

B. Chipping resulting in a weight loss exceeding 10% of the average weight of the blocks shall be deemed grounds for rejection.

END OF SECTION

SECTION 31 37 00

RIPRAP AND ROCK LINING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Riprap placed loose.
2. Wire Caged Riprap.

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 31 23 23 - Backfill.
3. Section 31 23 17 - Trenching.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Check dams and riprap placed loose:

1. Basis of Measurement: By cubic yard of riprap volume, riprap only.
2. Basis of Payment: Includes preparation of surface, compaction, placing of riprap material.

B. Wire caged rip rap:

1. Riprap:
   a. Basis of Measurement: By cubic yard of riprap volume, riprap only.
   b. Basis of Payment: Includes preparation of surface, compaction, placing of riprap material.
2. Wire mesh, geotextile, tie wire, angle iron, and other appurtenances:
   a. Basis of Measurement: By square yard of riprap area encaged in completed installation. Wastage will not be paid for.
      1) Measurement is based on actual coverage area. Where the Drawings require wire mesh both above and below the riprap blanket, both layers are included the pay item, but the coverage area is not doubled for purposes of measurement.
   b. Basis of Payment: Includes cutting and placement of wire mesh material both above and below the riprap, geotextile fabric, tie wires, and angle irons.

C. Bid items for riprap, rock check dams or other specific erosion control features that appear on the Bid Form apply only to features designed and directed by the Engineer. They do not include preparation of the Storm Water Pollution Prevention Plan (SWPPP) or implementation of any Best Management Practices (BMPs) stipulated therein. Separate bid items are provided for preparation and implementation of the SWPPP. Contractor is wholly responsible to prepare and implement the SWPPP to the satisfaction of relevant governmental authorities for the prices given under the SWPPP bid items.

1.3 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Gradation of rock.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with State of New Mexico Department of Transportation standard, if related to roadway construction or drainage.

C. Samples of riprap material shall be provided to the Engineer for inspection and approval for every 500 cubic yards of riprap delivered to the site.

D. Submit representative samples of riprap for testing using the Los Angeles Abrasion Test using ASTM-C131 and for Soundness Testing using ASTM C-88.

1. Loss of aggregate from abrasion test shall not exceed 40 percent. Sample results shall be provided to the Engineer for every 500 cubic yards of riprap delivered to the site.

2. Loss of aggregate for soundness test shall not exceed 15 percent. Sample results shall be provided to the Engineer for every 500 yards of riprap delivered to the site.

3. Riprap testing shall be covered under the testing allowance.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish materials in accordance with State of New Mexico Department of Transportation standards, Section 602.

B. Riprap:

1. Shall comply with New Mexico Department of Transportation standards, Section 602.2

2. Angular shaped rock:

a. Minimum size (as measured in the smallest dimension):

1) Class A Wire enclosed riprap:

a) At least 50% of the rock shall be a minimum of 4 inches measured in the smallest dimension. Remaining smaller rock shall not be smaller in any dimension than the smallest mesh openings.

2) Uncaged riprap and rock check dams:

a) 8” minimum rock dimension, measured in the smallest dimension.

b. Solid and nonfriable.

C. Wire mesh:

1. Non-raveling, uniform, hexagonal double-twisted galvanized wire mesh, with a diameter of at least 0.087", with 2½" x 3¼" mesh openings.

2. Shall comply with New Mexico Department of Transportation standards, Section 602.2.2.2

D. Selvedges:

1. Selvedge wire with a diameter of at least 0.150-inch.

2. Shall comply with New Mexico Department of Transportation standards, Section 602.2.2.2.3

E. Stakes:

1. 4"x4"x3/8" angle iron, per New Mexico Department of Transportation standard, Section 602.

2. Lengths per Drawings.

F. Tie Wire:

1. Soft tempered Class 3 zinc coated 0.120-inch diameter tie wire.

G. Geotextile Fabric:

1. Provide non-woven geotextile (filter fabric) Class 1, as per New Mexico Department of Transportation standards, Section 604.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Do not place riprap over frozen or spongy subgrade surfaces.

3.2 PLACEMENT

A. Riprap locations, dimensions, and quantities shown on Drawings are approximations only, and are subject to change based on finished grade. Final quantities, dimensions, and locations of riprap to be determined in field by Engineer after installation of pipeline and related facilities.

B. Filter fabric:

1. Place Class 1 non-woven geotextile (filter fabric) between the riprap and the supporting soil.

C. Installed Thickness: As shown on Drawings, or as directed in field by Engineer.

D. Wire enclosure: Where wire enclosure is to be used, enclose rock in wire mesh and anchor in place as indicated on Drawings.

E. Class A Riprap Placement

1. Shall comply with New Mexico Department of Transportation standards, Section 602

2. Enclose Class A riprap with wire mesh drawn tightly on all sides. The Contractor may connect wire mesh using approved fasteners or lacing wire. Weave adjacent edges at least once with double loops of lacing wire that is as strong and flexible as the mesh.

3. Provide continuous lacing as far as possible that passes through each mesh opening. Where splicing is necessary, overlap the lacing at least 12 inches.

4. Space galvanized wire ties connecting top and bottom mesh layers approximately 24 inches on centers. Anchor the ties to the bottom wire-fabric layer. Extend the ties through the rock layer and secure to the top wire-fabric layer. Anchor wire-enclosed riprap to slopes with steel stakes driven into the Embankment. Space stakes in accordance with the Contract.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE AND GRAVEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate base course.
2. Clean gravel.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Preparation of site for base course.
2. Section 31 23 17 - Trenching: Compacted fill under base course.
3. Section 31 23 23 - Backfill: Compacted fill under base course.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Aggregate Base Course:

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, scarifying substrate surface, placing aggregate to the depths and at the locations indicated on the Drawings, and compacting.

B. Clean Gravel

1. Basis of Measurement: By the square yard to depth indicated on Drawings.
2. Basis of Payment: Includes supplying fill material, stockpiling, placing gravel to the depths and at the locations indicated on the Drawings, and compacting.

1.3 REFERENCES

A. New Mexico Department of Transportation (NMDOT) Standard Specifications for Highway and Bridge Construction.

B. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

C. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with NMDOT standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base Course:

1. Base course gradation shall have a percent passing sieve sizes as shown in TABLE 304, SECTION 304-BASE COURSE, New Mexico Department of Transportation Standard Specifications for Highway and Bridge Construction, latest edition.

B. Clean Gravel (Class I crushed stone):

1. Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 – 50
No. 200	0 - 5

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

C. Subgrade surface shall be kept at all times in such manner that it will drain readily and effectively.

D. Mix aggregate material to provide a homogenous mixture of uniformly dispersed materials as placed in position for compacting.

3.3 AGGREGATE PLACEMENT

A. Spread aggregate over prepared substrate in layers that will permit the required density be obtained. Density requirements will be determined by AASHTO T-180.

B. Compact each layer of material full width with: (1) two passes of a 50 ton compression type roller, or (2) two passes of a vibratory roller having a minimum dynamic force of 40,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute, or (3) eight passes of a 10 ton compression-type roller, or (4) eight passes of a vibratory roller having a minimum dynamic force of 30,000 pounds impact per vibration and a minimum frequency of 1,000 vibrations per minute.

C. No displacement (pumping) of subgrade soils shall be visually observed when loaded by heavy equipment traffic.

D. Level and contour surfaces to elevations and gradients indicated.

E. Incorporate only suitable roadway excavation material into embankments. Compact material placed in all embankment layers and the material scarified in cut sections to a uniform density of not less than 95% Standard Proctor density.

F. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

G. Maintain optimum moisture content of fill materials to attain required compaction density.

H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat Surface: 3/8 inch measured with 10-foot straight edge in any direction.

C. Maximum Variation from Thickness: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Field testing of density and moisture content of in-place material will be performed in accordance with Nuclear Method, ASTM D6938.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests: One test every 2,500 square feet or portion thereof, at locations directed by Engineer.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts.
4. Manual gates and related hardware.
5. Removal, relocation, salvage, and/or reconstruction of existing fence.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Fencing:

1. Basis of Measurement: By linear foot to fence height specified, based on specified post spacing.
2. Basis of Payment: Includes posts, rails, tension wire, fabric, gates, hardware, accessories, and attachments.

1.3 REFERENCES

A. ASTM International:

1. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
6. ASTM A585 - Standard Specification for Aluminum-Coated Steel Barbed Wire.
7. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
8. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
9. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

10. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
11. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
12. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric.
13. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
14. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
15. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
16. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
17. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. Chain Link Fence Manufacturers Institute:

1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

A. Fence Height: 8 feet nominal.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Personnel Gates: 3 ft.

D. Vehicle Gates: 20 ft double-swing, consisting of two (2) 10 ft swinging sections.

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

C. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Perform installation in accordance with ASTM F567.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer's name.

D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing Steel: ASTM F1083 Schedule 40 galvanized steel pipe, welded construction; coating conforming to ASTM F1043 Type A on pipe exterior and interior.

B. Fabric Wire Steel: ASTM A392 zinc coated wire fabric.

C. Barbed Wire: ASTM A121 galvanized steel or ASTM A585 aluminum coated steel; 12 gage thick wire, 3 strands, and 4-point 14 gage barbs at approximately 5 inches on-center.

D. Concrete: 3,000 psi concrete.

2.2 COMPONENTS

A. Line Posts: 2.38-inch diameter.

B. Corner and Terminal Posts: 2.88 inch.

C. Gate Posts: 4.0-inch diameter.

D. Horizontal Rail: 1.66-inch diameter, plain end, sleeve coupled.

E. Gate Frame: 1.66-inch diameter for fittings and truss rod fabrication.

F. Fabric: 2-inch diamond-mesh interwoven wire, 9-gauge thick, top salvage twisted tight, bottom selvage knuckle end closed.

G. Tension Wire: 7 gauge thick steel, single strand, galvanized.

H. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Cast steel, pressed steel, or malleable iron; galvanized, sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Galvanized cast steel or pressed steel, to accommodate 3 strands of barbed wire, single arm, sloped to 45 degrees.

D. Gate Hardware: Center gate stop and drop rod; two 180-degree gate hinges for each leaf.

2.4 GATES

A. General:

1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings or by Engineer in the field.

2. Factory-assembled gates.

3. Design gates for operation by one person.

B. Swing Gates:

1. Fabricate gates to permit 180-degree swing.

2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

3. Gate center stop: Mushroom type, galvanized cast iron, 1 3/8” slot, 4” long anchor

2.5 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M; ASTM A153/A153M for components; ASTM A392 for fabric; 2.0 oz/sq ft coating.

B. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq ft coating.

C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set intermediate, terminal, and gateposts plumb, in concrete footings with top of footing 1 inch above finish grade of base course and 1 inch below top of gravel. Slope top of concrete for water runoff.

C. Line Post Footing Depth below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gateposts.

F. Install top rail through line post tops and splice with 6-inch long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 7 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 1 inch above finished base course grade.

L. Ensure final grade of gravel is 1 inch above bottom of fence material, leaving the fence fabric embedded 1 inch into the 2-inch thick gravel layer.

M. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

N. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.

O. Install bottom tension wire stretched taut between terminal posts.

P. Install support arms sloped outward and attach barbed wire; tension and secure, with barbed wire installed with lowest strand not less than 8 feet from ground level.

Q. Support gates from gateposts. Do not attach hinged side of gate from building wall.

R. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf.

S. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings, if double gates are called for on the Drawings.

1. Use mushroom-type gate center stop, set in concrete.

T. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.

U. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

V. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

W. Extend concrete footings 2 inches above grade, and trowel, forming crown to shed water.

X. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 REMOVING EXISTING FENCE

A. All existing fences to be removed shall be recorded photographically or by video prior to removal or modification, to document pre-existing condition.

B. Existing fences requiring removal and reconstruction shall be rebuilt to the same condition as the original fence or better.

C. The materials in existing fences to be removed and rebuilt shall be salvaged and incorporated in the rebuilt fences. Fence materials damaged beyond reuse during removal or handling must be replaced at no additional expense to the Owner.

D. The costs associated with the removal and rebuilding of existing fences at the original location is considered incidental to the construction of the utility. If the fence is relocated as instructed by the Engineer, a separate bid item will be included in the Bid Schedule.

E. Posts shall be firmly reset to the line shown on the Drawings, or as directed by the Engineer. The spacing of the posts and the material to be strung and secured to the posts is to be the same as the original fence.

F. New tie material or staples must be used to fasten the fence material to the posts.

3.3 ERECTION TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch.

C. Maximum Offset From Indicated Position: 1 inch.

D. Minimum distance from property line: 6 inches.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of subsoil.
2. Placing topsoil.
3. Seeding, Hydroseeding, Seed Drilling.
4. Seed Protection, Mulching
5. Maintenance.

B. Related Sections:

1. Section 31 22 13 - Rough Grading: Rough grading of site.
2. Section 31 23 17 - Trenching: Rough grading over cut.
3. Section 31 23 23 - Backfill

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Grassed Areas:

1. Basis of Measurement: By linear foot of centerline within the disturbed area of pipeline right of way and temporary use area. Lump sum for each site.
2. Basis of Payment: Includes preparation of subsoil, topsoil, placing topsoil, seeding, watering and maintenance to specified time limit.

1.3 REFERENCES

A. Federal Specifications:

1. OF-241 - Fertilizers, Mixed, Commercial.

B. ASTM International:

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. NNDA: Navajo Nation Department of Agriculture

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, and other accessories.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Perform Work in accordance with Navajo Nation Department of Agriculture standards.

C. Seed mixtures must be certified. There shall be no primary or secondary noxious weeds in the seed mixtures.

D. Temporary Best Management Practices (BMPs) must be installed along areas where sediment is being transported out of the construction area. Fiber rolls (mulch socks) rip rap blankets, rip rap check dams, soil cement, soil berms, surface roughening, or other appropriate BMPs shall be used in these areas. Such BMPs shall be included in the Storm Water Pollution Prevention Plan (SWPPP) provided and implemented by the Contractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Product storage and handling requirements shall be as specified in applicable sections of these Specifications and in accordance with recommendations of the supplier.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.8 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Do not commence seeding until all work that could require ground disturbance has been completed, tested, and approved.

C. Contractor is advised that there are three (3) Navajo Nation Department of Agriculture (NNDA) seed mixtures included in the appendices, Selection of specific mixture will depend on existing vegetation and soil type at each location. Contractor shall coordinate with Engineer prior to purchasing seed to determine exactly where to use each seed mixture.

D. Contractor shall coordinate seeding dates to coincide with the dates stipulated in the NNDA re-vegetation requirements and stipulations.

1. Contractor shall indicate exact proposed re-seeding dates in project schedule, and shall notify the Engineer as early as possible of any deviations from this proposed seeding schedule.

1.9 MAINTENANCE SERVICE

A. Section 01 00 00 - Execution Requirements: Requirements for maintenance service.

B. The cover will be maintained by occasional mowing, spot spraying, reseeding weak areas, or by controlled burns. Maintain seeded areas for three months from Date of Substantial Completion. Maintenance shall include weekly watering.

C. After the first full season of growth (not the first year) the cover should be mowed or grazed to control annual weeds to encourage good growth. Timing of mowing should avoid nesting times of birds (indicated in Environmental Requirements, Appendix C).

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Furnish materials in accordance with Navajo Nation Department of Agriculture standards. Refer to seed mixtures provided in Appendix C.

B. Engineer, in consultation with NNDA, shall determine which seed mixture applies at each location within the project. Contractor is responsible to coordinate with Engineer to determine proper seed mix prior to purchasing seed.

C. In developing seed mixtures, the percentage of each included species should first be determined. This percentage, which should total 100, is then multiplied by the recommended seeding rate for the concerned species. This will give the required pounds PLS for that species in the mix.

2.2 SOIL MATERIALS

A. Topsoil: Excavated from site and free of weeds.

2.3 ACCESSORIES

A. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

B. Erosion Fabric: Jute matting, open weave.

C. Herbicide: If required, Owner and Engineer’s approval must be obtained prior to use.

D. Stakes: Softwood lumber, chisel pointed.

E. String: Inorganic fiber.

F. Mulch:

1. Mulch of any kind shall not be used on Tribal lands.

PART 3 EXECUTION

3.1 GENERAL

A. Prepare and restore site per applicable NNDA Revegetation Plan, included in Appendix C to the Contract Documents.

B. Seed and reclaim all disturbed areas, including temporary construction easements and any areas disturbed by construction traffic.

C. Temporary fence gates along the pipeline alignment must be kept closed to manage the livestock in the pipeline area.

3.2 EXAMINATION

A. Verify prepared soil base is ready to receive the Work of this section.

3.3 PREPARATION OF SUBSOIL

A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas. The heel of a boot should not sink in more than ½ to 1 inch.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.

C. Topsoil removed from the right-of-way must not be mixed with sagebrush debris which may impede seed germination during the revegetation process.

D. In areas needing reseeding, the top layer of soil shall be softened by ripping and disking prior to seeding to create the soil structure necessary to allow for seed germination.

E. Scarify subsoil to depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.4 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 6 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

3.5 SEEDING

A. Use seed mixture indicated by Engineer, based on land ownership and native vegetation.

B. Apply seed at rates specified by NNDA for their respective seed mixtures. Use seed drill followed by drag packer over area to incorporate seed approximately ½ inch deep.

C. Planting Season: See Article 1.8. of this Section.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Seed placement rows on steep slopes should not be placed parallel to the down slope, but at angles to the down slope to prevent the formation of gullies and rills.

F. A seed drill followed by a drag packer shall be required unless specific exceptions are authorized in writing by the Engineer.

G. Some hand seeding may be needed along steep slopes where equipment is difficult to use.

H. Apply water with a fine spray immediately after each area has been seeded. Saturate to 4 inches of soil.

3.6 HYDROSEEDING

A. Hydroseeding shall only be allowed where it is physically unfeasible to seed drill.

B. Hydroseeding shall not be performed without prior written authorization by the Engineer.

C. Apply fertilizer and seeded slurry with hydraulic seeder at an approved rate evenly in one pass.

D. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

E. If hydroseeding is used, the specified rates of seed application shall be doubled.

3.7 SEED PROTECTION

A. Cover seeded slopes where grade is 3:1 or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

1. All slopes around the perimeters of sites shall be covered with erosion fabric, regardless of grade.

B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

C. Secure outside edges and overlaps at 36 inch intervals with stakes.

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

F. Protection of seeded areas from traffic: Contractor shall take measures as required by the Owner, Engineer, and/or land controlling agencies to prevent traffic on re-seeded areas. Such measures may include warning signs, fence post barricades, earthen berms, and/or other measures at intersections of seeded ROW and existing roadways and driveways, and at other locations as directed by Engineer. Earthen berms shall extend the full width of the disturbed area, with dimensions as directed in field by Engineer.

G. All seed protection measures, including traffic prevention, shall be subject to approval of land-controlling agencies.

3.8 MULCHING

A. Do not apply mulch on Tribal lands.

B. Any mulching shall be anchored in place by crimping or other method approved by Engineer.

3.9 MAINTENANCE

A. Immediately reseed areas showing bare spots.

B. Repair washouts or gullies.

C. Protect seeded areas with warning signs during maintenance period.

3.10 SCHEDULE

A. All utility routes, disturbed areas, vault areas, and non-traveled areas in road rights-of-way to be reseeded when Work is completed in affected areas.

END OF SECTION

SECTION 33 05 23.13

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation for approach trenches and pits.
2. Horizontal directional drilling.
3. Pipe.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 03 60 00 - Grout.
3. Section 31 23 17 - Trenching.
4. Section 31 23 23 - Backfill.
5. Section 33 11 13- Public Water Transmission Systems.
6. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Horizontal Directional Drilling:

1. Basis of Measurement: By linear foot.
2. Basis of Payment: Includes excavation, drilling, carrier pipe, spacers, end seals, transition couplings, accessories, tests, and backfill.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
3. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
4. ASTM D2152 - Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
5. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping

6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
8. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
10. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings.

C. American Water Works Association (AWWA):

1. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1,500 mm), for Water Distribution.
2. AWWA M23 – PVC Pipe – Design and Installation

D. NSF International Standard / American National Standard (ANSI)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects

E. Underground Solutions

1. OB-8-273 – Recommended Cutting Procedure for Fusible PVC Pipe
2. OB-8-274 – Recommended Cold Weather Fusion Procedures for Fusible PVC Pipe
3. OB-8-275 – Recommended Intermediate Fusion Procedures for Fusible PVC Pipe
4. Operational Quick Cards
5. Operational Procedural Documents

F. National Utility Contractors Association:

1. NUCA - HDD Installation Guidelines.

1.4 DESIGN REQUIREMENTS

A. Design Criteria:

1. Drilling Steering System: Remote with continuous electronic monitoring of boring depth and location.
2. Directional Change Capability: 90 degree with 363-foot radius curve for 16-inch FPVC, or minimum bending radius specified by manufacturer of the carrier pipe.
3. Ratio of Reaming Diameter to Pipe Outside Diameter:
    a. Nominal Pipe Diameter of 6 Inches and Smaller: 1.5 maximum.
    b. Nominal pipe diameter larger than 6 Inches: Submit recommended ratio and reaming procedures for review.

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Submit technical data for equipment, method of installation, proposed horizontal and vertical alignment and beginning and end points (if different than those shown on the plans), and proposed sequence of construction, including project schedule.

2. Include information pertaining to pits, dewatering, method of spoils removal, equipment size and capacity, equipment capabilities including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade and detection of surface movement, name plate data for drilling equipment and mobile spoils removal unit, design requirements per Section 1.4 of this technical specification.

C. Contractor Qualifications: Submit history of previous work completed of equivalent nature and scope. Include qualification and experience of key personnel and references for work completed.

D. Manufacturer’s technical data showing complete information on material composition, physical properties and dimensions of the new pipe and fittings. Manufacturer’s recommendations for transport, handling, and storage of pipe and fittings shall be included.

E. Submit necessary occupancy permit for installations along or under public throughways and lands, and railroad right of way, if not already obtained by the Engineer.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Contingency plans for the following potential conditions:

1. Unforeseen subsurface conditions.

2. Damage to other existing utilities.

3. Soil heaving or settlement.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

D. Record actual depth of pipe at 25 feet intervals.

E. Record actual horizontal location of installed pipe.

F. Show depth and location of abandoned bores.

G. Record depth and location of drill bits and drill stems not removed from bore.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with the following:

1. Applicable New Mexico state standards

2. NUCA HDD Installation Guidelines.

3. ASTM F1962.

1.8 QUALIFICATIONS

A. Contractor: Company specializing in performing work of this section with minimum 3 years documented experience.

B. The Contractor must be certified by the HDD system manufacturer as a fully trained user of the HDD system. Operation of the HDD system shall be performed by trained personnel. Such training shall be conducted by a qualified representative of the HDD system manufacturer.

C. Fusible PVC pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment. Personnel directly involved with installing the new pipe shall receive training in the proper methods for joining the pipe. Such training shall be conducted by a qualified representative of the fusion equipment manufacturer. Installation of other materials shall be performed by personnel qualified by the specific product manufacturer.

D. HDD contractor shall have at least 5 years experience and have installed at least 5,000 LF.

E. HDD contractor must have experience installing fusible PVC pipe of similar diameter to that of the proposed project.

1.9 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. The Contractor shall transport, handle, and store pipe and fittings as recommended by the manufacturer.

C. New pipe and fittings that are damaged before or during installation shall be repaired or replaced, as recommended by the manufacturer or required by the Engineer. The costs of such repair or replacement shall be borne by the Contractor and be accomplished prior to proceeding with the project.

D. The Contractor shall deliver, store and handle other materials as required to prevent damage. Materials that are damaged or lost shall be repaired or replaced by the Contractor at no additional expense to the Owner.

E. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

F. Protect piping system pieces from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

G. Accept products on site in manufacturer’s original containers or configuration. Inspect for damage.

H. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.

I. Support pipes with nylon slings during handling.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Section 01 00 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

C. The Contractor shall comply with all other Federal, State, and local environmental requirements including, but not limited to, storm water runoff, construction dewatering, disposal of drilling fluid, and hazardous waste management and disposal.

1.12 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with the New Mexico Department of Transportation (NMDOT), local Municipal Public Works Department (if applicable), and utilities within construction area.

PART 2 PRODUCTS

2.1 DRILLING FLUID

A. Drilling Fluid: Liquid bentonite clay slurry; totally inert with no environmental risk.

2.2 CARRIER PIPE

A. Furnish materials in accordance with New Mexico state standards.

B. Casing Pipe shall be as shown on drawings.

2.3 FUSIBLE POLYVINYLCHLORIDE PIPE

A. Fusible polyvinylchloride (FPVC) plastic material for pipe shall conform to AWWA C900 and ASTM D1784 cell classification 12454. Pipe sizes shall conform to AWWA C900 for CIOD pipe or ASTM D2241 for IPS pipe. Pressure class/rating and dimension ratio shall be as recommended by the pipe manufacturer for HDD water main applications.

B. Refer to Specification 33 11 13.

2.4 FILL MATERIALS

A. Excavated and reused soil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.5 WATER SOURCE

A. Water: Potable, obtained from utility source.

2.6 UNDERGROUND PIPE MARKERS

A. Tracer Wire: Magnetic detectable conductor insulated with high density polyethylene (HDPE) or UF- XHHW in accordance with physical and electrical properties per ASTM D-1248.

1. Tracer wire shall be rated for “Direct Burial”, 30 volts, and be appropriate for installation in Horizontal Directional Drill (HDD) applications,
2. Tracer wire shall be constructed of copper clad hard drawn extra high strength (EHS) tracer wire with a steel core or engineer approved equal, and
3. Tracer wire must be appropriately sized and installed to be compatible with the pullback rating of the equipment being used.

B. Splice Connectors: Model LV 9500 Blazing Snap-locking waterproof connectors pre-filled with silicone or engineer approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

3.2 PREPARATION

A. Call Local Utility Line Information service at not less than three working days before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Locate, identify, and protect utilities indicated to remain from damage.

C. Identify required lines, levels, contours, and datum locations.

D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 DEWATERING

A. Intercept and divert surface drainage, precipitation, and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Develop and maintain substantially dry subgrade during drilling and pipe installation.

C. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 EXISTING WORK

A. Maintain access to existing community facilities and homes as well as other remaining active installations requiring access. Modify installation as necessary to maintain access.

3.5 EXCAVATION

A. Excavate approach trenches and pits in accordance with shop drawings and as site conditions require. Minimize number of access pits.

B. Provide sump areas to contain drilling fluids.

C. Install excavation supports as specified in Section 31 23 17.

D. Restore areas after completion of drilling and carrier pipe installation.

3.6 DRILLING

A. Drill pilot bore with vertical and horizontal alignment as indicated on Drawings.

B. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.

1. Monitor depth, pitch, and position.
   a. Monitor position every 5’ along pilot bore.
2. Adjust drill head orientation to maintain correct alignment.
3. Monitor with Walkover system, or other proven type.
   a. System shall be setup and operated by personnel trained and experienced with system.
   b. Calibrate and verify electronic monitor accuracy in presence of Engineer before proceeding with other drilling. When required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.

C. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.

D. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.

1. Monitor down-hole.
2. Provide relief holes when required to relieve excess pressure.
3. Minimize heaving during pullback.

E. After completing pilot bore, remove pilot drill bit.

F. Install reaming drill bit and begin reaming bore hole to minimum diameter.

G. Minimum Reamer Size:

1. 24-inch for 16-inch pipe.

H. The HDD Machine shall have at least 60,000 pound pullback capacity.

3.7 DRILLING OBSTRUCTIONS

A. When obstructions are encountered during drilling, notify Engineer immediately. Do not proceed around obstruction without Engineer's approval.

B. For conditions requiring more than 12 inches deviation in horizontal or vertical alignment, notify Engineer immediately. Do not proceed around obstruction without Engineer's approval.

C. Maintain adjusted bore alignment within easement or right-of-way.

3.8 PIPE INSTALLATION

A. After reaming bore to minimum required bore diameter, remove drill bit. Install reamer with a swivel and pipe pulling head.

1. Select reamer with minimum bore diameter required for pipe installation.

B. Attach pipe to pipe pulling head. Pull reamer and pipe to entry pit along pilot bore.

C. Inject drilling fluid through reamer to stabilize bore and lubricate pipe.

D. Install piping with horizontal and vertical alignment as shown on Drawings.

E. Protect and support pipe being pulled into bore so pipe moves freely and is not damaged during installation.

F. Do not exceed pipe manufacturer's recommended maximum pullback forces.

G. Do not exceed pipe manufacturer's recommended minimum bending radius.

H. Install trace wire continuous with each bore. Splice trace wire only at intermediate bore pits. Tape or insulate trace wire to prevent corrosion and maintain integrity of pipe detection.

1. Terminate trace wire for each pipe run at structures along pipe system.

2. Provide extra length of trace wire at each structure, so trace wire can be pulled 3 feet out top of structure for connection to detection equipment.

3. Test trace wire for continuity for each bore before acceptance.

I. Provide sufficient length of carrier pipe, minimum 10', to extend past termination point to allow connection to other pipe sections.

J. Allow minimum of 24 hours for stabilization after installing pipe before making connections to pipe.

K. Mark location and depth of bore with spray paint on paved surfaces, and wooden stakes on non-paved surfaces at 25-foot intervals.

3.9 FPVC FUSION PROCESS

A. Refer to Section 33 11 13.

3.10 SLURRY REMOVAL AND DISPOSAL

A. Contain excess drilling fluids at entry and exit points until recycled or removed from site. Provide recovery system to remove drilling spoils from access pits.

B. Remove, transport and legally dispose of drilling spoils.

1. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.

2. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.

C. When drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.

D. Complete cleanup of drilling fluid at end of each workday.

3.11 DISINFECTION AND FLUSHING

A. Disinfection and flushing shall be conducted in accordance with Section 33 13 00.

3.12 PRESSURE AND LEAKAGE TESTING

A. Pressure and leakage testing shall be conducted in accordance with Section 33 11 13 as applicable.

3.13 BACKFILL

A. Install backfill as specified in Section 31 23 17 and 31 23 23.

B. Backfill approach trenches and pits with subsoil fill to contours and elevations of surrounding existing grade.

C. Compact subsoil fill as specified in Section 31 23 23 to minimum 95 percent of maximum density.

3.14 INSTALLATION TOLERANCES

A. Section 01 00 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Horizontal Position: 12 inches.

C. Maximum Variation From Vertical Elevation: 12 inches.

D. Minimum Horizontal and Vertical Clearance from Other Utilities: 24 inches.

E. When pipe installation deviates beyond specified tolerances, abandon bore, remove installed pipe, re-bore, and reinstall pipe in correct alignment.

F. Fill abandoned bores greater than 3 inches in diameter with grout or flowable fill material.

3.15 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Compaction Testing: As specified in Section 31 23 23.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.16 MANUFACTURER'S FIELD SERVICES

A. Section 01 00 00 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish field technical assistance during following periods of installation:

1. Unloading of materials and components.

2. Prior to commencing excavation and during excavation as requested.

C. Certify that equipment for drilling has been properly set-up and is ready for drilling.

3.17 CLEAN-UP

A. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits. Clean up excess slurry from ground.

B. Restore approach trenches and pits to original condition.

C. Remove temporary facilities for drilling operations.

END OF SECTION

SECTION 33 05 23.16

TRENCHLESS UTILITY INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavation for approach trenches and pits.
2. Casing pipe.
3. Carrier pipe.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete: Concrete materials.
2. Section 31 23 17 - Trenching.
3. Section 31 23 23 - Backfill.
4. Section 33 11 00 - Water Utility Distribution Piping.
5. Section 33 13 00 - Disinfection of Water Utility Distribution.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Jacked Pipe:
1. Basis of Measurement: By linear foot measured on invert of jacked pipe from face to face of jacked pipe.
2. Basis of Payment: Includes excavation, jacked pipe, grout, spacers, accessories, tests, and backfill.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M133 - Standard Specification for Preservatives and Pressure Treatment Processes for Timber.
2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Railway Engineering and Maintenance-of-Way Association:
1. AREMA - Manual for Railway Engineering.

C. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
4. ASTM A449 - Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated 120/105/90 ksi minimum tensile strength General Use.

5. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
6. ASTM C33 - Standard Specification for Concrete Aggregates.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
10. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3).
11. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
12. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D. American Wood-Preservers' Association:
1. AWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.
2. AWPA C3 - Piles - Preservative Treatment by Pressure Process.

E. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

F. National Utility Contractors Association:
1. NUCA - Pipe Jacking & Microtunneling Design Guide.
2. NUCA - Trenchless Excavation Construction Equipment & Methods Manual.

1.4 DESIGN REQUIREMENTS

A. Design casing pipe and tunnel liner joints of leak proof construction. Design for earth and/or other pressures present plus highway H20 loading or railway E80 loading with associated recommended impact loading.
1. Highway Crossings: Design tunnel for earth and/or other pressure loads present, plus AASHTO H20 live loading.
2. Railroad Crossings: Design tunnel for earth and/or other pressure loads present, plus railroad E80 live loading with 50 percent added for impact.

B. Design bracing, backstops, and use jacks of sufficient rating for continuous jacking without stoppage, except for adding pipe sections and as conditions permit, to minimize tendency of ground material to "freeze" around casing pipe.

C. Design steel tunnel lining in accordance with AREMA Manual for Railway Engineering, Section 4.15.5.

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Installation Plan: Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignment.

C. Submit BIA occupancy permit for installations along or under public throughways and lands, if not already obtained by the Engineer.

D. Submit emergency response procedures to handle situations when conduit is compromised and jeopardizes integrity of installation or safety.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with applicable New Mexico state standards, NUCA Trenchless Excavation Construction Equipment & Methods Manual, NUCA Pipe Jacking & Microtunneling Design Guide, AREMA guidelines.

B. When boring, jacking or tunneling under State or Municipality highways and railroads, make application for and obtain occupancy permit.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.
   1. Work Experience: Include projects of similar magnitude and conditions.
   2. Furnish list of references upon request.

1.9 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Administrative Requirements: Pre-Construction Conference.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for delivering, handling, storing, and protecting products.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping system pieces from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.

D. Accept system components on site in manufacturer's original containers or configuration. Inspect for damage.

E. Use wooden shipping braces between layers of stacked pipe. Stack piping lengths no more than 3 layers high.

F. Store field joint materials indoors in dry area in original shipping containers. Maintain storage temperature of 60 to 85 degrees F.

G. Support casing and carrier pipes with nylon slings during handling.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Section 01 00 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.12 FIELD MEASUREMENTS

A. Verify invert elevations prior to excavation and installation of casing.

1.13 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with NMDOT, local Municipal Public Works Department (if applicable), and utilities within construction area.

PART 2 PRODUCTS

2.1 CASING AND JACKING PIPE MATERIALS

A. Furnish materials in accordance with New Mexico state standards.

B. Steel Casing Pipe: ASTM A53/A53M, 35,000-psi minimum yield strength, casing diameter and minimum wall thickness as indicated on Drawings. Full circumference welded joints in accordance with AWS D1.1 to withstand excavation forces.

2.2 CARRIER PIPE MATERIALS

A. Public Water Transmission Systems: As specified in Section 33 11 13.

2.3 COVER MATERIALS

A. Soil Backfill for Trench Approaches and Pits to Finish Grade: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.4 ACCESSORIES

A. Pipe Casing End Seals: Seamless, vulcanized edge, pull-on casing end seals composed of a minimum 1/8" thick 60 durometer synthetic neoprene rubber. Includes ½" wide T304 stainless steel bandings with 100% non-magnetic worm gear mechanism.

B. Pipe Casing Spacers: Constructed of heavy duty, two piece, 8" wide 14-gauge stainless steel bands, or hot rolled 14-gauge circular carbon steel with thermoplastic powder coating for extra corrosion protection, as identified on the Drawings or on the Bid Form. Bands bolt together to form a shell around the carrier pipe, with 10-gauge stainless steel or carbon steel risers (material to match bands) and glass filled polymer runners to support the carrier pipe within the casing pipe maintaining a minimum clearance of 1" between the casing ID and the spacer OD.

C. Pressure Grout Mix: One part portland cement, and 6 parts mortar sand mixed with water to consistency applicable for pressure grouting.

D. Mortar Sand: ASTM C404.

E. Portland Cement: ASTM C150, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

3.3 DEWATERING

A. Intercept and divert surface drainage precipitation and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Develop substantially dry subgrade for prosecution of subsequent operations.

C. Comply with New Mexico state standards and requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 EXISTING WORK

A. Maintain access to existing community facilities and homes as well as other remaining active installations requiring access. Modify installation as necessary to maintain access.

3.5 PITS OR APPROACH TRENCHES

A. Excavate approach trenches or pits in accordance with installation plan and as site conditions require.

B. Ensure casing entrance face as near perpendicular to alignment as conditions permit.

C. Establish vertical entrance face at least 1 foot above top of casing.

D. Install dewatering measures and excavation supports as specified in Section 31 23 17.

3.6 CASING PIPE INSTALLATION

A. Boring:
1. Push pipe into ground with boring auger rotating within pipe to remove spoil. Do not advance cutting head ahead of casing pipe except for distance necessary to permit cutting teeth to cut clearance for pipe. Arrange machine bore and cutting head to be removable from within pipe. Arrange face of cutting head to provide barrier to free flow of soft material.
2. When unstable soil is encountered during boring retract cutting head into casing to permit balance between pushing pressure and ratio of pipe advancement to quantity of soil.
3. When voids develop greater than outside diameter of pipe by approximately one inch, grout to fill voids.
4. When boring is obstructed, relocate, jack, or tunnel as directed by Engineer.

B. Jacking
1. Construct adequate thrust wall normal to proposed line of thrust.
2. Impart thrust load to pipe through suitable thrust ring sufficiently rigid to ensure uniform distribution of thrust load on full pipe circumference.

3.7 PRESSURE GROUTING

A. Pressure grout annular space between casing pipe and surrounding earth.

3.8 CARRIER PIPE INSTALLATION

A. Clean, inspect, and handle pipe in accordance with Section 33 11 00.

B. Place carrier pipe in accordance with Section 33 11 00. Exercise care to prevent damage to pipe joints when carrier pipe is placed in casing.

C. Support pipeline within casing on spacers at intervals identified on Drawings or according to manufacturer's instructions if interval is not identified on Drawings, so no external loads are transmitted to carrier pipe. Attach supports to barrel of carrier pipe; do not rest carrier pipe on bells.

D. Install pipe casing end seals at ends of casing.

3.9 TOLERANCES

A. Do not over cut excavation by more than 1 inch greater than outside diameter of casing pipe.

B. Install casing pipe to vertical and horizontal alignment on Drawings within plus or minus 3 inches prior to installation of carrier pipe.

C. Install pipe bells with minimum ½-inch clearance to casing.

3.10 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Compaction Testing: As specified in Section 31 23 23.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.11 MANUFACTURER'S FIELD SERVICES

A. Section 01 00 00 - Quality Requirements: Requirements for manufacturer's field services.

B. Furnish field technical assistance during following periods of casing installation:
   1. Unloading of casing materials and components.
   2. Prior to commencing excavation and during excavation as requested.

3.12 REMOVAL OF FACILITIES AND CONTROLS

A. Remove temporary facilities for casing installation and jacking operations in accordance with Section 01 00 00.

END OF SECTION

SECTION 33 11 13

PUBLIC WATER TRANSMISSION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings for public line including potable water line.
2. Tapping Sleeves and Saddles.
3. Corrosion Protection and Monitoring Systems.
4. Underground and Aboveground Pipe Markers.
5. Bedding and Cover Materials.
6. Source Quality Control and Assurance.

B. Related Sections:

1. Section 02 21 13 - Surveying.
2. Section 03 30 00 - Cast-in-Place Concrete
3. Section 31 23 17 - Trenching: Execution requirements for trenching.
4. Section 31 23 23 - Backfill: Requirements for backfill to be placed.
5. Section 32 92 19 - Seeding.
6. Section 33 12 16 - Water Utility Valves.
7. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 DEFINITIONS

A. Throughout the Drawings and Specifications, the terms “jointed PVC pipe” and “bell-and-spigot PVC pipe” shall be used interchangeably.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:

1. Basis of Measurement: By the linear foot.
2. Basis of Payment: Includes hand trimming, excavation, trenching, piping and fittings, all valves and appurtenances not listed separately on the Bid Form, bedding, backfill, compaction, tracer wire, detectable warning tape, above ground pipe marker posts, concrete thrust restraints (where applicable), mechanical joint restraints, connection to public utility water source (if not separately listed on Bid Form). Excavation requiring specialized equipment for rock removal, as defined in Section 31 23 18 - Rock Removal, will be paid for separately per Article 1.2 of same said Section 31 23 18. Backfill required to replace removed rock, whether imported or processed on-site to meet the project specifications, will be incidental to the cost of pipe installation. Similarly, soil cement, if used, shall be considered incidental to the cost of the pipe installation.

a. Fusible PVC pipe, where required, shall be included in the same bid item and paid on the same basis as bell-and-spigot PVC pipe. All materials, labor, and equipment required to fuse, install, and test fusible PVC pipe shall be included in this same pay item.

3. The actual laboratory cost of compaction, concrete, and destructive fusible PVC joint testing shall be reimbursed to the Contractor, upon submittal of invoices. Work performed by Contractor or Sub-Contractor related to such testing, or any other work performed by laboratory personnel outside of actual compaction, concrete, and PVC joint testing, shall be considered incidental and shall not be reimbursable from testing allowance. Work shall be coordinated and directed by Engineer. Contractor shall pay for all failed tests.

4. The cost of work associated with hydrostatic pressure testing for main pipeline and wash crossings shall be paid via a separate bid item. The cost of work associated with hydrostatic pressure testing for all other facilities (including site piping, chlorination buildings, etc.) for which a separate bid item is not provided shall be considered incidental to their respective bid items.

5. The cost of work associated with disinfection and bacteriological testing for main pipeline and wash crossings shall be paid via a separate bid item. The cost of Contractor's work associated with disinfection and bacteriological testing for all other facilities (including site piping, chlorination buildings, etc.) for which a separate bid item is not provided shall be considered incidental to their respective bid items.

a. Laboratory costs associated with bacteriological testing shall be considered incidental and are not eligible for reimbursement under the testing allowance.

B. Cathodic Protection:

1. Basis of Measurement: Per each for valves and steel casings. Cathodic protection for metallic fittings or any other unlisted non-stainless metallic components within corrosive soil zones shall be considered incidental. Cathodic protection monitoring stations for casings outside of corrosive soil zones shall be considered incidental.

2. Basis of Payment: Includes cathodic protection design, installation, energizing, adjustment, testing and all materials not listed separately on the bid form.

1.4 REFERENCES

A. Contractor shall refer to the latest revision of all standards listed herein.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

C. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

D. American Society for Testing and Materials International (ASTM):

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A139 – Standard Specification for Electric Fusion (Arc) Welded Steel Pipe.
5. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
7. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
8. ASTM F594 – Standard Specification for Stainless Steel Nuts.
9. ASTM A1011 – Standard Specification for Steel, sheet and strip, Hot Rolled, Carbon, Structural, High Strength Low Allow, High Strength Low Alloy with Improved Formability, and Ultra High Strength.
10. ASTM A1018 – Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Commercial, Drawing, Structural, High Strength Low Alloy, High Strength Low Allow with Improved Formability, and Ultra High Strength.
11. ASTM B843 – Standard Specification for Magnesium Alloy Anodes for Cathodic Protection.
12. ASTM D653 - Terminology Relating to Soil, Rock, and Contained Fluids.
13. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
14. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
15. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
16. ASTM D2152 - Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.
17. ASTM D2467 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
18. ASTM D2487 - Classifications of Soils for Engineering Purposes (Unified Soil Classification System).
19. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
20. ASTM D3363 – Standard Test Method for Film Hardness by Pencil Test.
21. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

22. ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate Zinc Rich Primers by Solvent Rub ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
23. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
24. ASTM E165 – Standard Practice for Liquid Penetrant Examination for General Industry.
25. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
26. ASTM F1057 - Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique.

E. American Water Works Association (AWWA):

1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110/ ANSI A21.10 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1,219 mm), for Water.
4. AWWA C111/ ANSI A21.11 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C115 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
7. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
8. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
9. AWWA C200 - Steel Water Pipe 6 In. (150 mm) and Larger.
10. AWWA C206 - Field Welding of Steel Water Pipe.
11. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
12. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
13. AWWA C209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
14. AWWA C210 – Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
15. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
16. AWWA C219 – Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
17. AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.

18. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
19. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1,500 mm).
20. AWWA C901 - Polyethylene Pressure Pipe and Tubing, 1/2 In. through 3 In. (13 mm through 76 mm), for Water Service.
21. AWWA M11 – Steel Pipe: A Guide for Design and Installation
22. AWWA M23 – PVC Pipe – Design and Installation

F. National Association of Corrosion Engineers International (NACE)

1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. TM0497 – Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
3. SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.

G. Manufacturer's Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

H. Society for Protective Coatings:

1. SSPC-SP5 White Metal Blast Cleaning

I. National Fire Protection Agency (NFPA)

1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

J. NSF International Standard / American National Standard (ANSI)

1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

K. National Association of Pipe Fabricators (NAPF)

1. NAPF 500 – Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

L. American Welding Society (AWS)

1. AWS D1.1 – Structural Welding Code

M. Underground Solutions

1. OB-8-273 – Recommended Cutting Procedure for Fusible PVC Pipe
2. OB-8-274 – Recommended Cold Weather Fusion Procedures for Fusible PVC Pipe
3. OB-8-275 – Recommended Intermediate Fusion Procedures for Fusible PVC Pipe
4. Operational Quick Cards
5. Operational Procedural Documents

1.5 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, and accessories.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. In addition to the submittal requirements listed above, Contractor shall also submit:

1. Pipe restraint plan indicating all locations where restrained pipe joints, including all fusible PVC joints, will be used to comply with the Drawings and Specifications. The plan shall be in tabular form indicating beginning and ending station of every restrained section, as well as in graphic form with restrained sections indicated graphically with written station numbers. Locations of any bell ends fabricated as part of the fusible PVC pipe shall be noted. Locations of all appurtenances, including air valves and flush valves, shall be noted on the graphic and tabular plans with corresponding station numbers. The pipe restraint plan must be submitted and approved by the Engineer before any submittals for pipe, fittings, restraints, or casing will be approved.

2. Shop drawings for any custom-fabricated steel fittings which clearly show compliance with AWWA M11, AWWA C207 and AWWA C208. Include design calculations, as applicable.

3. Submittal for all coatings which demonstrate compliance with relevant AWWA and NACE standards.

4. Design calculations, drawings and material data sheets for cathodic protection and monitoring systems. Include assumptions and basis for design. Include approximate locations of anodes, test stations and isolation kits. Include copy of cathodic protection specialist’s NACE certification.

5. As-built drawings and any Contractor-provided survey data. Refer to Sections 01 00 00 – Basic Requirements and 02 21 13 - Surveying.

6. Shop drawings, with dimensions, of fusible PVC sweeps.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Refer to Sections 01 00 00 – Basic Requirements and 02 21 13 – Surveying.

1. All fusible PVC joint fusion documentation and fusion machine data logs shall be submitted to Engineer with project record documents, in addition to ongoing data log and analysis submittals during construction process.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property without prior authorization, or in areas obstructing pedestrian or vehicular traffic.

D. Store PVC materials out of sunlight. Contractor shall, at Contractor's expense, provide and maintain tarps, temporary shelters, or other such measures as necessary to protect PVC materials from sunlight. Such tarps or shelters must be adequately vented to prevent excess heat accumulation

1. Any PVC materials judged by the Engineer to be sun-damaged, including tan to brown discoloration, blistering, roughening or cracking of surface, or embrittlement, prior to installation shall be rejected.

E. Coated pipe shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coating.

F. Coated pipe and other components shall be handled with wide belt slings, padded forks or other means to prevent damage to coating. Chains, cables or other equipment likely to damage coating or pipe shall not be used.

G. PVC pipe shall be bundled or stacked throughout the shipping, storage and handling process in accordance with AWWA M23 and pipe supplier's recommendations, whichever is most stringent. Excessive bundling or stacking that results in bends, kinks, gashes or uncorrectable ovality shall be rejected. Transport and handle pipe in accordance with AWWA M23 and pipe supplier's recommendations, whichever is most stringent. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

1. Any pipe showing a crack, or which has received a blow that may have caused an incident fracture, even though no fracture can be seen, shall be rejected.

2. Any pipe with a scratch or gouge greater than 10% of the wall thickness will be rejected.

H. Prior to shipment and again prior to installation, all materials shall be visually inspected for damage, including coatings and surfaces. Any damaged materials shall be repaired to original standards or replaced.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Polyvinyl Chloride (PVC):

1. All PVC pipe, whether jointed or fusible, shall conform to AWWA C900, on all PVC pipe 4" diameter and greater, and ASTM D1785, Schedule 80, on all PVC

pipe less than 4" diameter. Testing shall be in accordance with the referenced AWWA standard for all pipe types.

2. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.
3. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
4. Pipe shall be blue in color for potable water use.
5. Nominal laying length:
    a. Jointed PVC pipe: 20 feet.
    b. Fusible PVC pipe: 40 or 45 feet, or custom lengths as required on Drawings
6. Gasketed Joints:
    a. Joints per ASTM D3139.
    b. Use rubber gaskets manufactured and tested in accordance with ASTM F477.
    c. For all PVC casings at gasoline and petroleum line crossings or where otherwise indicated on Drawings, use petroleum-resistant gaskets in accordance with ASTM F477 or fusible PVC pipe joints.
7. Fusible PVC Pipe:
    a. Manufacturers:
        1) Underground Solutions, Inc.
        2) Substitutions: Not allowed
    b. Fusible polyvinyl chloride pipe shall be extruded with plain ends. The fused ends shall be square to the pipe and free of any bevel or chamfer. Bell ends with gaskets, if required, shall be extruded with the pipe.
        1) Any bell ends shall be noted on the Contractor's pipe restraint submittal for Engineer's approval prior to extrusion.
8. Fittings:
    a. Ductile iron on all PVC pipe 4" diameter and greater.
        1) Refer to specifications for ductile iron fittings in this section, below.
    b. All PVC pipe and fittings less than 4" diameter shall be solvent welded Schedule 80.
    c. Solvent-weld joints are not permitted on pipe 4" diameter and greater.
9. Mechanical Joint Restraints:
    a. Refer to specifications for ductile iron joint restraints in this section, below.
10. Fusible PVC Sweeps:

a. Fusible polyvinyl chloride sweeps shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined using the sweep or bend.

b. Fusible polyvinyl chloride sweeps shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible polyvinyl chloride sweep.

c. Standard fusible polyvinyl chloride sweep angles shall not be greater than 22.5 degrees.

11. Mechanical bell harnesses shall not be allowed. All PVC pipe joint restraints shall be provided using fusible PVC pipe.

12. Substitutions: Contractor has option of using Fusible PVC where Bell and Spigot PVC is specified at the Contractor's expense. Fusible PVC is considered a restrained pipe system.

B. Ductile Iron Pipe, Joints, and Fittings:

1. Manufacturers:

a. US Pipe

b. American Pipe

c. Substitutions: Approved Equal

2. Ductile iron pipe:

a. To be used at control valve vaultpump station sites, underneath and within 5 feet of buildings only, and at site drain outfalls specifically identified as ductile iron on the drawings. Do not use ductile iron pipe at any other location without Engineer's prior written approval.

b. Pipe Class: AWWA C151, for nominal thickness, rated water working pressure and maximum depth of cover.

c. 350 psi working pressure.

d. Cement Mortar Lining: AWWA C104, standard thickness.

e. Exterior coating:

1) Buried service (site piping only, excluding chlorination building): Bituminous coating, per AWWA C151.

2) Inside and underneath pumping station, surge tank buildings, and chlorinator buildings: TNEMEC N140 Pota-Pox Plus, rated for use in corrosive environments.

3. Fittings: Ductile iron.
    a. Compact MJ fittings conforming to AWWA C153 or AWWA C110, unless otherwise noted on Drawings.
    b. Flanged fittings shall conform to AWWA C110. Do not use flanged fittings for buried installations unless otherwise noted on Drawings.
        1) Contractor responsible to ensure that all mating flanges have compatible diameters, bolt sizes and drill patterns. Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.
    c. Pressure rating of MJ joints, fittings and gaskets shall be at least 350 psi, unless otherwise noted on the Drawings.
    d. Pressure rating of flanged fittings and gaskets shall at least match that of the attached pipe, unless otherwise noted on the Drawings.
    e. Marked with pressure rating, nominal diameter of opening, manufacturers' identification, country where cast, and degree of bend.
    f. Coatings:
        1) Main line fittings, gate valve, flush valve, and air valve assembly components (including spools):
            a) All interior and exterior surfaces shall be coated with fusion-bonded epoxy in accordance with AWWA C116.
            b) All coatings shall be applied in strict accordance with coating manufacturer's recommendations.
            c) All fusion-bonded epoxy coatings shall be factory tested holiday-free.
        2) Site piping fittings for use on PVC and DIP (for use within tank site, pump station, and surge tank sites only):
            a) Exterior: Bituminous Coating: AWWA C110.
            b) Interior: Cement Mortar Lining: AWWA C104, standard thickness.
            c) Encasement: Encase in polyethylene as described in this section.
        3) Inside and underneath chlorination building:
            a) Exterior coating: 2-part polyamide epoxy, rated for use in corrosive environments.
            b) Interior: Cement Mortar Lining: AWWA C104, standard thickness.
    g. Provide sacrificial anode cathodic protection where indicated in Section 3.12 of this technical specification.

4. Joints:
    a. Mechanical and Push-On Joints: AWWA C111. Only use where expressly allowed on the Drawings. No DI pipe joints shall be allowed underneath or within 5 feet of any structure.
        1) All push-on joints shall be fully restrained
        2) TR Flex restrained pipe joints
        3) TR Flex lockers shall be ductile iron. Redwood or other materials shall not be allowed.
    b. Flanged Joints: AWWA C115; ASME B16.1.
5. Mechanical Joint Restraints:
    a. Mechanical joint restraints for all fittings and appurtenances, unless otherwise noted on Drawings.
    b. Mechanical joint restraints shall be “EBAA Iron, Megalug®” Series 2000PV and 2200, Romac Romagrip, Smith-Blair Cam-Lock, or approved equal, for all pipe 4” diameter and greater.
    c. Wedge assemblies and glands shall be fusion bonded epoxy coating in accordance with AWWA C116 or Mega-Bond coated, interior and exterior.
    d. Provide sacrificial anode cathodic protection where indicated in this Section.
    e. Stainless steel 304 bolts, nuts and washers for all buried applications, provided by manufacturer especially for use with their respective components. If fitting manufacturer cannot supply stainless steel bolts contractor may provide bolts from another source; however, contractor is solely responsible to ensure fit and compatibility of said bolts.
6. Jackets:
    a. AWWA C105 polyethylene jacket, Installation Method “A”.
    b. Double-wrap all ductile iron components, unless they are cathodically protected, or pump station and surge tank building risers.
    c. Inner PE jacket shall be V-Bio enhanced, minimum thickness: 8 mil
    d. Outer PE jacket shall be standard polyethylene, minimum thickness: 8 mil
    e. Secure PE jackets with ultra-high molecular weight (UHMW) polyethylene film tape, 10 mil thickness.
        1) Do not use duct tape to tape the PE jackets.
    f. Do not use polyethylene encasement on ductile iron fittings with cathodic protection.
7. Building Risers Coatings:
    a. Exterior surfaces ductile iron pipe and welded fittings risers into pump station and surge tank building shall include wax-applied tape coating, manufactured and installed in accordance with AWWA C217, applied

with a minimum overlap width of 1-inch and a total coating thickness shall be a minimum of 80 mils. Prior to wax-tape, a thin coat of wax-tape primer must be applied.

C. Steel Pipe and Fittings:

1. Pipe fabrication:

a. For pipe 26" diameter and greater, fabricate arc-welded spiral seam steel pipe: ASTM A139, Grade B, C, D or E. For pipe 26" diameter or less, fabricate pipe per ASTM A-53 B.

b. Fabricated in accordance with AWWA C200, except:

1) Steel plate: ASTM A283, Grade C or D, or ASTM A36.

2) Steel sheet: ASTM A1011, Designation SS, Grade 40, 45 or 50; or ASTM A1018, Designation SS, Grade 40.

3) Standard wall thickness, unless otherwise indicated on Drawings.

2. Fittings and Special Sections:

a. Steel for fittings: ASTM A283, Grade C or D, or ASTM A36 for carbon steel.

b. Welding: Per AWS D1.1. All welding must be completed prior to application of lining and coatings, unless otherwise permitted by the Engineer. In no case shall any welding damage lining or coatings.

c. Dimensions in accordance with AWWA C208.

d. Custom fabricated fittings shall be designed and fabricated in accordance with AWWA M11, with outlet reinforcements per AWWA M11. All other standards and specifications for steel, welds, coatings, flanges and dimensions of component fittings provided herein shall apply equally to custom fabricated fittings.

e. No custom-made fittings shall be used without prior written approval by the Engineer.

3. Flanges:

a. Flange class as noted on Drawings.

b. Pressure rating of flanges and gaskets shall meet or exceed surge pressure rating of attached pipe.

c. Coatings and linings shall be continuous to the ends of pipe and backs of flanges.

d. Do not apply coatings to mating surfaces of flanges.

e. Gaskets shall be ring-type, per AWWA C207, unless the flanged connection is between PVC and steel, in which case full face type gaskets with outer diameter equal to that of the flange shall be used.

f. Retainers shall be fabricated of phenolic or other suitable material as recommended by manufacturer and conforming to NSF 61, with minimum thickness of 1/8 inch and minimum dielectric strength of 500 volts/mil.

g. Nitrile sealing rings.

h. Steel washers shall be 1/8-inch thick.

i. All bolts, nuts and washers shall be stainless steel 304, unless otherwise noted. All bolts shall be provided by manufacturer especially for use with their respective fittings. If manufacturer cannot supply stainless steel bolts, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

j. Bolt shall be long enough to protrude through the assembled nut at least two threads but not more than ½-inch.

k. Contractor is responsible to ensure that all pipe flanges that connect to valve body flanges have the same dimensions, drill pattern, bolt hole diameter and equal or higher pressure rating as the valves to which they are connected.

1) Overdrill bolt holes as necessary, provided such overdrilling is within manufacturer's recommended tolerances.

l. Contractor shall be responsible to verify compatibility of all flange bolt patterns prior to purchasing materials and shall notify the Engineer in the event that alternate bolt patterns are required to mate flanges.

4. Coatings:

a. For small diameter pipes, where it is not practical to apply fusion bonded epoxy coatings, the use of liquid epoxy coatings in accordance with AWWA C210 may be considered in lieu of fusion-bonded epoxy for interior surfaces, with prior approval by the Engineer. The burden shall be upon to Contractor to submit sufficient data and obtain Engineer's approval for such substitutions.

b. Pipes underneath welded steel tanks: Coating requirements per technical specification 09 97 14 Water Storage Tank Painting and drawings.

c. Road crossings casings:
1) Open cut casings shall be coated in bituminous paint.
2) Bore and Jack casings do not require coating.

d. All coatings shall be NSF 61-approved.

5. Additional Coatings:

a. Exterior surfaces of all buried non-stainless steel pipe, welded fittings, and flanges shall include a wax-tape coating, manufactured and installed in accordance with AWWA C217, applied with a minimum overlap width of 1-inch and a total coating thickness shall be a minimum of 80 mils. Prior to wax-tape, a thin coat of wax-tape primer must be applied.

6. Field Welding Materials:

a. Pipe: AWWA C206.

7. Stainless Steel Pipe and Fittings

a. Use where called-out on Drawings as Stainless Steel

b. Stainless Steel 304

c. Pressure rating: Not less than 350 psi Cold Working Pressure

d. Annealed

e. NSF 61 Compliant

2.2 TAPPING SLEEVES AND SADDLES,

A. Tapping Sleeves:

1. Manufacturers:

a. Mueller Co.

b. Romac Industries, Inc

c. JCM Industries

d. Ford Meter Box Company, Inc

e. Smith-Blair, Inc

f. Substitutions: Approved equal.

2. Tapping sleeves shall be used for all taps larger than 2-inches.

3. Shall be fusion-bonded epoxy-coated steel sleeves.

4. All sleeves shall be specifically designed for use on the type of pipe that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.

6. Sleeve Working pressure rating: 250 psi

7. Tapping sleeves shall be used on non-fusible PVC, unrestrained bell-and-spigot PVC, and DI pipe only. All taps on fusible PVC pipe or restrained PVC pipe shall be performed using MJ reducing tees.

8. Tapped Outlet: FNPT or MJ, as indicated on Drawings

9. Tapping sleeves within “Corrosive Soil Areas” as designated on the Drawings and this Section shall require cathodic protection.

10. All pipe taps shall be made with an engineer approved tapping machine.

11. Threadolets, where called for on Drawings, shall be welded to the pipe, ground, and blasted (if possible) prior to applying fusion-bonded epoxy coating to the pipe.

B. Tapping Saddles:

1. Manufacturers:

a. Romac Industries, Inc. Model 202-NS

b. Substitutions: Approved equal.

2. Tapping saddles shall be used for taps 2-inches or smaller.

3. Nylon coated ductile iron tapping saddles with stainless steel dual compression straps.

4. All saddles shall be specifically designed for use on the type of pipe that is being tapped.

5. All bands, straps, bolts, nuts and washers shall be SS 304. All bolts shall be provided by manufacturer especially for use with their respective components.
6. Saddle Working pressure rating: 350 psi.
7. Tapping saddles shall be used on non-fusible PVC, unrestrained bell-and-spigot PVC, and DI pipe only. All taps on fusible PVC pipe or restrained PVC pipe shall be performed using MJ reducing tees.
8. Tapped Outlet: FNPT or MJ, as indicated on Drawings
9. All pipe taps shall be made with an engineer approved tapping machine.
10. Threadolets, where called for on Drawings, shall be welded to the pipe, ground, and blasted (if possible) prior to applying fusion-bonded epoxy coating to the pipe.

2.3 CORROSION PROTECTION AND MONITORING SYSTEMS

A. Design:

1. Systems shall be consistent with corrosion engineering principles set forth in NACE SP0169 (latest revision) and NACE TM0497 (latest revision).
2. Design and installation of corrosion protection and monitoring systems shall be performed under the direction of a NACE-accredited Cathodic Protection Specialist.
3. Materials shall be as manufactured by Corrpro, Inc., or approved equal.
4. Minimum design life: 20 years.
5. Polarization potential: Between -0.85 and -1.10 volts
6. Contractor may use the soil resistivity data provided in this section as a basis for design of corrosion protection systems.

B. Flange isolation kits:

1. Isolate new cathodically protected structures from adjacent metallic structures not to be protected, as needed, with flange isolation kits consisting of dielectric material with a minimum dielectric strength of 500 volts/mil.
2. Isolate steel pipes with corrosion monitoring from adjacent metallic structures not to be monitored, with flange isolation kits consisting of dielectric material with a minimum dielectric strength of 500 volts/mil.
3. Flange isolation kits shall include bolt isolating sleeves: Sleeves shall be full length, extending halfway into both steel washers when installed, with tube thickness of 1/32-inch. Sleeves shall be composed of mylar or other suitable material recommended by flange manufacturer.
4. Steel washers shall have sufficient diameter to fit over the bolt isolating sleeve.
5. Isolating washers shall be 1/8-inch thick, with inner diameter sufficient to fit over bolt isolating sleeve, composed of phenolic or other suitable material with minimum dielectric strength of 500 volts/mil as recommended by flange manufacturer.

C. Magnesium alloy anodes in accordance with ASTM B843.

1. Actual weight shall be based on NACE engineer’s design, with minimum weight of 17 lb.

2. Shall contain mild steel core centered within anode with silver-solder connect between steel core and anode cable.
3. Anode cable shall be No. 12 AWG or larger if required by NACE-certified designer.
4. Anode to cable connection, exposed mild steel and exposed cable shall be potted in epoxy.
5. Anodes pre-packages within chemical backfill specifically designed for the type of anode being used.

D. Cable:

1. Cable material:
   a. Anode leads: Solid, plain annealed cable, #12 AWG or larger
   b. Test leads: Stranded, plain annealed cable, #12 AWG or larger
   c. Bonding cables: Stranded, plain annealed cable, #6 AWG or larger
2. Cable insulation: Rated for 600 volts and direct burial. Min. thickness of 100 mils. All cables shall have HMWPE insulation
3. Unspliced for entire length of connection, sufficient length to avoid mechanical stress on cable.
4. Anode-to-cable connection shall be factory-made.
5. Cable colors:
   a. Anode: Black
   b. Pipe / structure: White
   c. Casing: Yellow
   d. Foreign Line (if any): Red

E. Test stations:

1. Test stations for cathodic protection systems use three-cable type to carry current from the anode, carry current to the protected structure and to monitor soil-to-structure potential.
2. For corrosion monitoring of buried ferrous pipe and appurtenances without cathodic protection, use two-cable type such that one cable can be used for bonding and one cable can be used for determining soil-to-structure potentials.
3. Enclosures shall be post mounted cast aluminum test stations.
4. Provide 0.01 ohm calibrated shunts and variable resistors to allow current output of each anode to be measured and adjusted. Variable resistors (for use in terminal boxes only) shall be sized to allow current of each anode to be adjusted to within 150% of one another without overheating.

F. Welds: Thermite “cad” welds.

G. Warning tape: Shall be minimum 3-inch wide, suitable for direct burial, yellow with black lettering, full-length printed with “Caution – Cathodic Protection Cable Buried Below”.

2.4 UNDERGROUND PIPE MARKERS

A. Furnish materials in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Tracer Wire: 12 AWG, high carbon grade steel center, Solid Copper, Single Conductor, 30V, Blue Jacket, 30 mil high-density polyethylene insulation wire or equal, for underground installation. Conductor must be at least 21% conductivity for locate purposes. Break load of 452 lbs.

C. Metal-backed detectable water marker tape: Bright colored, metallized for detection by above-ground metal detector, continuously printed, minimum 6 inches wide by 4-mil thick, manufactured for direct burial service, imprinted with "BURIED WATER SERVICE" in large letters.

2.5 ABOVE-GROUND PIPE MARKERS

A. Carsonite marker posts, blue, with Navajo Tribal Utility Authority (NTUA) decals. Decals to be specified by NTUA and provided by the Contractor. Place markers as specified on the Drawings.

2.6 PIPE SUPPORTS AND ANCHORING

A. Metal for pipe support brackets: ASTM A123/A123M, galvanized structural steel thoroughly coated with bituminous paint.

B. Metal tie rods and clamps or lugs: Galvanized steel sized in accordance with NFPA 24 thoroughly coated with bituminous paint.

2.7 CASING SPACERS

A. Polyethylene Casing Spacer

B. Two part or multi segmented

C. Stainless steel 304 bolts, nuts and washers. All bolts shall be provided by the fitting manufacturer especially for use with their respective components.

2.8 BEDDING AND BACKFILL MATERIALS

A. As specified in Section 31 23 23.

2.9 ACCESSORIES

A. Concrete for Thrust Restraints (where applicable): Conform to Section 03 30 00, with minimum compressive strength of 3,000 psi.

B. Steel rods, bolt, lugs and brackets

1. For applications not in contact with soil: ASTM A36/A36M or ASTM A307 carbon steel.

2. For buried applications: Stainless steel 304.

2.10 SOURCE QUALITY CONTROL

A. Pipe:

1. Polyvinyl chloride (PVC): Factory test all PVC pipe, both jointed and fusible types, in accordance with AWWA C900 or AWWA C905, as applicable.

a. Fusible PVC: In addition to standard AWWA C900/905 testing, the pipe supplier shall perform third party quality assurance for the pipe lot to be provided for the project. Testing shall be per the pipe supplier protocol and include the following tests as a minimum:

1) Heat reversion testing per ASTM F1057

2) Acetone immersion testing per ASTM D2152

3) Flattening testing per AWWA C905

2. Ductile iron: Factory test in accordance with AWWA C151 and AWWA C104.

3. Steel: Factory test in accordance with AWWA C200, ASTM A53, or ASTM A139.

a. Hydrostatic test: Factory test per AWWA C200 to stress steel to 23,000 psi for at least 15 minutes, or longer as needed to allow for thorough inspection. Conduct test after all formed and welded ends have been completed and attached.

b. Repair defects and re-test prior to applying lining and coating.

B. Fittings:

1. Ductile iron (DI): Factory test in accordance with AWWA C153 and AWWA C110, as applicable.

2. Steel:

a. Steel plate fittings: Factory test fittings fabricated from steel plate to stress steel under hydrostatic pressure to 23,000 psi for at least 15 minutes, or longer as needed to allow for thorough inspection.

b. Steel pipe fittings: Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds. Perform dye penetrant test on welds in accordance with ASTM E165.

c. Pipe should conform to ASTM A53, ASTM A139 or AWWA C200.

d. Remove all defects disclosed during testing, re-weld and re-test the fitting.

3. Fusible PVC Sweeps:

a. In addition to the factory testing of the fusible PVC pipe stipulated above prior to bending, every individual fusible PVC sweep shall be inspected for quality at the factory after bending, as follows:

1) Visual inspection for heat damage, kinks, ovality, and other irregularities

2) OD measurements parallel and perpendicular to the plane of the bend, at not less than five (5) locations evenly spaced along the length of the sweep

C. Coatings:

1. All fusion-bonded epoxy coatings shall be factory tested holiday-free.
2. Cure testing for fusion bonded or liquid epoxy coatings: ASTM D4752 and ASTM D3363, Every 1000 sq. ft. of epoxy coating.
3. Holiday testing for epoxy, cold-applied, or wax tape coatings:
   a. All fusion-bonded epoxy coatings, cold-applied, or wax tape coatings on all pipes and fittings shall be holiday tested prior to installation, at no additional cost to the Owner.
   b. Perform testing in accordance with NACE Standard SP0274, using electrical holiday tester. Use test voltage below:

Total Coating Thickness (Mils)	Test Voltage (Volts)
20 or less	6000
30	7500
50	9000
70	11500
80 or more	12000

   c. All holidays shall be repaired and re-tested, at no additional cost to the Owner.
4. Touch up and repair of Fusion Bonded Epoxy Coatings
   a. Applies to all FBE coated valves for field repair of minor holidays, scratches, breaks or other damage to FBE coating.
   b. Does not include repair or touch up of systemic or large area holidays in FBE coating. Repair of systematic holidays or damaged areas larger than three (3) sq. in. will require the damaged coating be ground off and the valve be newly shop-coated.
   c. Materials and application:
      1) NSF/ ANSI 61 certified, two-part, 100% solids, liquid epoxy coating meeting the requirements of AWWA C210.
         a) Manufacturer: 3M Scotchkote Epoxy Coating 323, OAE.
         b) If temperature is below 55 degrees Fahrenheit, the metal substrate shall be pre-heated in accordance with coating manufacturer's recommendations prior to applying the coating.
   d. Prepare surface and apply per coating manufacturer's instructions for use as a field repair material.

D. All shop welding shall be performed by certified welders.

E. All shop welds shall be tested by ultrasonic or radiographic methods in accordance with AWS D1.1.

F. Engineer reserves right to require additional holiday testing of any and all coated components that are suspected of having holidays in the field prior to installation. Costs of

failed tests shall be borne by the Contractor; costs of passed additional tests shall be reimbursable from the Testing Allowance.

2.11 SOURCE QUALITY ASSURANCE

A. Acceptance of materials will be based on compliance with relevant AWWA, ASTM and other relevant standards. Materials must pass all relevant tests prior to acceptance.

B. Compliance with standards will be determined based on:

1. Documentation of factory testing. Such tests must be completed in accordance with relevant AWWA, ASTM, AWS or other applicable standards. All testing must be completed and documented by qualified personnel. The Engineer reserves the right to observe the testing while in process and to demand all testing documentation at any time.

2. Inspection by the Engineer. The Engineer reserves the right to inspect all materials both during and after manufacture.

C. The Engineer reserves the right to demand evidence of certification of all personnel performing shop or field welding on steel pipe and fittings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing utility water main size, location, and invert, are as indicated on Drawings.

3.2 PREPARATION

A. Pre-Construction Site Photos:

1. Prior to beginning construction, take photographs or videotape along centerline of proposed pipe trench. The photos or video must include coverage of all areas and adjacent features that may potentially be impacted by the impending construction work.

2. Photographs shall be taken at a minimum of one for each 200 feet of pipe trench. Videos shall cover a maximum of 2,000 feet per video file.

3. Video or photographs shall be taken after Station markers or stakes are in place for the section of pipeline or site(s) to be recorded. Video or photos must include sufficient close-ups of stakes to clearly indicate the location.

4. Prior to groundbreaking on any section of pipeline or site work, video or photographs must be submitted to the Engineer for review and approved. Video or photo documentation must be approved as sufficient by Engineer before groundbreaking may proceed.

5. Show station markers, mailboxes, fences, structures, driveways, signs, culverts, and other existing site features.

6. Include project description, applicable stations or sites, and date taken in the file name of every photograph or video, using the following filename convention: “<project name>_<begin station>_to_<end station>_<date>”.

7. Video or photo submittals may be rejected because of failure to include or document any of the items above, a lack of visual or audio clarity, or for any other deficiency that prevents the Owner / Engineer from easily viewing and documenting the pre-construction conditions of the pipeline and sites.

8. If using video, Contractor must submit two (2) copies of the video documentation on DVD format as part of the submittal process. If using photographs, Contractor must submit 2 copies of digital photograph files in DVD format as part of the submittal process.

B. Construction staking:

1. Refer to Section 02 21 13 – Surveying.

C. Restricted and Culturally Sensitive Areas:

1. Contractor shall notify Engineer at least five (5) working days prior to any ground disturbing activity within 100 feet of any restricted area as designated on the Drawings; refer to Section 01 00 00.

2. The Owner's Surveyor will erect barricades at the limits of any truncated temporary construction easements. The Owner's archeologist will flag sensitive sites as designated on the Drawings.

3. Contractor shall erect orange construction fence at all flagged areas.

4. Contractor shall maintain all flags, stakes and barricades in place until the end of construction. Contractor shall notify Engineer in the event of damage or removal of said markers. Re-marking due to negligence by Contractor shall be subject to charge-backs to the Contractor.

5. No work shall be performed within 100 feet of any restricted area or truncated TCE unless barricades and/or flags are up.

6. No work shall be performed within 100 feet of any restricted area designated on the Drawings as requiring the Owner's archeologist's or archaeological monitoring unless the Owner's archeologist / archaeologist is physically present at the site.

3.3 TRENCHING

A. In accordance with Section 31 23 17.

3.4 BEDDING

A. In accordance with Section 31 23 23.

3.5 INSTALLATION – PIPE

A. Install bell-and-spigot PVC pipe in accordance with AWWA C605, AWWA M23 and pipe manufacturer's instructions, whichever is most stringent.

1. Use only lubricants supplied by the pipe manufacturer and apply to both bell and spigot ends of the joint, in accordance with manufacturer's recommendations.

2. Clean the gasket, bell, groove and spigot immediately prior to connecting pipe joints.

3. Do not over-insert pipe joints. Any over-inserted pipe joints shall be removed and the pipe bell and gasket inspected for damage. Any damaged bells or gaskets shall be discarded and replaced.

4. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

B. Install fusible PVC pipe in accordance with AWWA C605, AWWA M23 and pipe supplier's instructions, whichever is most stringent.

1. If ambient temperature drops below 40 degrees Fahrenheit refer to Underground Solutions Operational Bulletin for Cold Weather Installation (OB-8-274 012411).
2. When pulling fusible PVC pipe, do not exceed the supplier's maximum recommended safe pulling force.
3. Fused lengths of pipe shall be installed by lowering into the trench or excavation, using approved strapping per the pipe supplier's guidelines. The lowering operation, once initiated shall proceed until the entire length of the fused section of pipe is installed.
    a. Coordination of lifting equipment shall ensure that the fused pipe does not exceed the bending and buckling limitations of the pipe, per the pipe supplier's guidelines.
    b. Equipment shall be utilized and staged per the pipe supplier's guidelines.
    c. Under no circumstances will the pipe be "dropped" or "rolled" into the trench or excavation.
4. If the length of the fused pipe is longer than what the available equipment can lower into the trench or excavation at one time, equipment shall be staged so that lowering shall begin at one end of the installation, and proceed along the trench or excavation, so that the entire fused length is installed without exceeding the minimum bend radius of the fused pipe.
5. Pipe may also be installed by pulling it into the end of the trench via a sloped section that is constructed so as not to exceed the minimum bending radius of the pipe. Pipe may be pulled by the use of a pull head and winch or piece of equipment as recommended by the pipe supplier.
6. Initial lengths of installed fused polyvinyl chloride pipe shall be bedded and backfilled before any connections are made between adjacent lengths.
7. Initial lengths of installed fused PVC pipe shall be allowed to come to thermal equilibrium with the ground temperature at burial depth, by waiting at least 24 hours after installation prior to making connections such as air valves, isolation valves, or flush valves.
8. Where fusible PVC is to be installed inside a casing, remove the exterior weld bead prior to installation in the casing.
9. Connection between fusible PVC and jointed PVC pipe:
    a. Connections between fusible PVC and jointed PVC pipe shall be bell-and-spigot joints in accordance with this Section.
    b. Bevel the spigot end prior to insertion into the bell.
    c. Contractor shall coordinate to ensure bell/spigot pipe ends match up where fusible PVC pipe connects to jointed PVC pipe.
10. Fusible PVC pipe shall be used:

a. For all restrained pipe

b. At all cased road and pipeline crossings

c. At any location where required bending radius is shorter than the minimum bending radius allowable using bell-and-spigot joint deflection

d. At all locations where PVC pipe slope exceeds 20%

e. At all other locations indicated on the Drawings

f. At any other locations at Contractor's option and expense

C. Install ductile iron piping and fittings according to AWWA C600.

1. Encase all ductile iron pipe and fittings that are not cathodically protected except for riser pipes under chlorination building, in polyethylene, per AWWA C105, Method "A".

a. Use two (2) separate polyethylene jackets.

1) Inner jacket: V-bio enhanced polyethylene

2) Outer jacket: standard polyethylene

b. No tears, cuts, rips or other breaks in the polyethylene encasement shall be acceptable. No dirt, water or debris inside the encasement shall be acceptable.

c. When installing ductile iron pipe floor penetrations under buildings and concrete slabs, bring both layers of polyethylene into the slab inside the roof felt isolation joint. Trim and tape the PE at the mid-point of the slab thickness (e.g. 6" below the floor for a 12" slab). Wrap two layers of 30# roof felt outside both layers of polyethylene, extending 4" above and 4" below the slab. Trim the felt to 2" above the floor and seal with silicone. Extend PE encasement to PVC transition beyond building foundation.

d. When installing ductile iron pipe floor penetrations under chlorination building only, apply AWWA C-209 cold-applied tape coating per specifications to the riser pipe from the top of the floor to the buried ell. Wrap two layers of 30# roof felt outside both layers of polyethylene, extending 4" above and 4" below the slab. Trim the felt to 2" above the floor and seal with silicone. Encase the ell and horizontal pipe to the PVC transitions beyond the foundation in PE, per specifications.

e. When installing ductile iron floor drain lines, bring both layers of polyethylene into the slab, trim, and tape to pipe just below the inset floor drain.

f. When installing ductile iron floor drains for chlorination building only, apply AWWA C-209 cold-applied tape coating per specifications to the riser pipe from the inset floor drain to the buried ell. Encase the ell and horizontal pipe to the PVC transitions beyond the foundation in PE, specifications.

g. Do not polyethylene encase any ductile iron fitting that has cathodic protection.

h. Use only 10-mil UHMW polyethylene film to tape the PE jackets. Do not use duct tape.

2. All push-on joints, where allowed on Drawings, shall be installed using TR Flex restrained joints. Install restrained joints in accordance with manufacturer's recommendations.

D. Install steel pipe in accordance with AWWA M11. Field weld and test steel pipe, as needed, in accordance with AWWA C206, except as follows:

1. Test field welds by ultrasonic or radiographic method, in accordance with AWS D1.1.

2. Do not field weld pipe without permission from the Engineer.

Any damaged shop-applied coatings shall be repaired in accordance with this Section. In the event, that field repair is required due to damage of shop-applied coating, Contractor shall notify Engineer prior to making the repair.

E. Install cathodic protection for buried ferrous pipe, fittings and valves as indicated in the Corrosion Protection and Monitoring Systems provisions of this Section.

1. All buried steel and ductile iron pipe, whether cathodically protected or not, shall be joint bonded and connected to corrosion monitoring stations in accordance with the Corrosion Protection and Monitoring Systems provisions of this Section.

F. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings. Inspect each pipe and fitting prior to lowering into trench to ensure there is no damage to the pipe, fitting or coatings. Repair any damage prior to installation. Clean ends of pipe and remove foreign material from inside of pipe and fittings.

G. Maintain 10 ft horizontal separation of water main from sewer piping in accordance with local code.

H. Lay pipe in straight line and center pipe within trench. Re-lay pipe that is out of alignment.

I. Horizontal and vertical pipe bending, angles and joint deflections

1. All ells shall be one of the following standard angles: 11.25, 22.5, 45, 60 or 90 degrees. No other ell angles shall be allowed.

2. Actual horizontal and vertical angles required in the field shall be accomplished by a combination of allowable DI ells, fusible PVC sweeps, and/or pipe deflection (i.e. pipe bending or joint deflection, as specified below).

a. The plan and profile sheets show horizontal angles with DI ell(s) or fusible PVC sweep(s) called out. The contractor is responsible for installing the specified fittings at each location. In addition to the specified fitting(s), use joint deflection to achieve the specified horizontal angle. If a location is shown without specifying a fitting, use joint deflection to achieve the horizontal angle.

b. Vertical bends: The plan and profile sheets show required vertical ells and sweeps. Where fusible PVC sweeps are shown, they must be used. Where DI MJ ells are shown, either DI ells or fusible PVC sweeps may be used, at Contractor's option. Alternative methods, such as fusible pipe bending, may be considered on a case-by-case basis in the field at the Engineer's sole discretion, but the Contractor remains wholly responsible for meeting all design requirements set forth in the Drawings and Specifications.

c. At locations where fusible PVC sweeps are shown in plan and profile sheets, they must be used.

d. If the Contractor chooses to use DI ells or fusible PVC sweeps at any given location, the required length of restrained (fusible PVC) pipe must be used on both sides of the bend, whether the restraint length is shown on the plan and profile sheet, or not.

1) The plan and profile sheets assume that bends greater than 18° will be made using ells, that bends less than 9° will be made by pipe deflection ("roping"), and that angles in between could be made using either method. The fusible PVC call-outs at these locations on the plan and profile sheets are based on these assumptions. However, in some cases the Contractor may differ from these assumed methods. In such cases, it is the responsibility of the Contractor to provide adequate restraint length for all fittings, regardless of whether the plan and profile sheets indicate restrained pipe, or not. Refer to restraint detail sheet, DT-3.

3. Lateral pipe bending forces shall be isolated from all fittings.

4. PVC pipe deflections may be made either at joints or by pipe bending, as allowed by AWWA C605.

a. For jointed PVC pipes 12-inch diameter or smaller, pipe bending shall be allowed, provided that such bending complies with AWWA C605 and/or pipe manufacturer's minimum allowable bending radius, whichever is more stringent.

b. For jointed PVC pipes 14-inch diameter or larger, deflections shall be made at the pipe joints only.

c. For all pipe diameters, jointed PVC pipe joint deflection shall not exceed 1 degree per joint.

d. For fusible PVC pipe, deflection shall be accomplished by pipe bending. The pipe bending radius shall not be less than the minimum bending radius recommended by the pipe supplier.

1) If the ambient temperature is less than 40 degrees Fahrenheit, consult the pipe supplier for bending radius adjustments.

5. Steel and ductile iron pipe deflections shall be made at joints, provided pipe manufacturer's allowable deflection limits are not exceeded.

6. Mechanical Joints: contractor to abide by manufacturer's recommended maximum allowable deflection

J. Horizontal and vertical pipe line and grade

1. The horizontal and vertical lines and grades shown on the Drawings indicate the intent of the design. Actual horizontal and vertical lines and grades in the field may deviate from those shown on the Drawings, provided all of the following conditions are met:

a. Actual minimum slope of pipe shall not be less than 0.00100 ft/ft.

b. Actual maximum slope of pipe shall not be greater than 0.40000 ft/ft, except where otherwise noted on the Drawings.

c. Direction of pipe slope shall not differ from that shown on Drawings.

d. Minimum pipe cover of 4 feet shall be maintained throughout the project.

e. Additional minimum cover or specific minimum vertical clearances called out on the Drawings at specific locations, such as wash crossings, road crossings or pipeline crossings, shall be maintained.

f. In the case of horizontal bends, the outer wall of the pipe must remain at least 12 horizontal feet within the permanent right-of-way boundaries.

g. At bends near casings, pipe bending and/or off-set from centerline shall be done on the far side of the PI from the casing, to maximize the length of straight pipe in the sleeve on each side of the casing.

h. In certain locations, the pipe elevation and/or slope must remain as shown on drawings to facilitate pipe draining, maintain pressures, or other performance criteria. In such cases, deviation from the Drawings may not be allowed.

i. All deviations from the Drawings shall be documented by the Contractor and must be approved in advance by the Engineer.

j. All other specifications shall be met.

k. Any exceptions to the foregoing conditions must receive prior written approval by the Engineer.

2. No high points of any magnitude shall be allowed without an approved air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.

a. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid.

b. Additional air valves or pipe re-installation required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.

1) If the required air valve is located on a fusible or restrained section of main line, a reducing tee is required in lieu of tapping sleeve. If a reducing tee is required within a corrosive soil zone, Contractor shall provide cathodic protection for the tee at no additional cost to the Owner.

K. Install pipe to bear on the trench bottom along entire length of pipe. For jointed pipe, excavate bell holes in the bottom of the trench to prevent the bell from coming into contact with the sub-grade.

L. Do not lay pipe in wet or frozen trench.

M. Direction of pipe bells may be reversed for ease of installation, provided that all pipe material and installation meets applicable AWWA, ASTM, NTUA and material manufacturer's standards. On grades greater than 10%, install jointed pipe uphill.

N. Pipe expansion and contraction

1. Install pipe to allow for expansion and contraction without stressing pipe or joints.

O. Do not allow trench water, dirt, debris or other foreign material to enter the pipe during or after installation.

1. Keep pipe ends sealed after joining pipes, both while pipe string is laying on top of ground and after pipe is lowered into trench.

2. Close pipe openings with watertight plugs during work stoppages.

P. Clean inside of pipe by "pigging" immediately prior to connecting pipe ends to butterfly valves, elbows or other fittings that do not allow the pig to pass through. Seal all exposed pipe ends to prevent contamination after pigging.

1. Flanged ends shall be temporarily sealed using approved blind flanges. Straight pipe ends shall be temporarily sealed using approved pipe covers.

2. Pigging system shall be submitted to Engineer for approval prior to use.

Q. Install tracer wire continuous, taped to top of pipeline; coordinate with Sections 31 23 17 and 31 23 23.

R. Install metal-backed detectable water marker tape continuous over top of pipe, buried 18 inches above pipe; coordinate with Section 31 23 17 and 31 23 23.

S. Install thrust blocks at locations indicated on Drawings. Installation of thrust blocks shall not relieve the Contractor of responsibility to provide pipe restraints as indicated on Drawings and Specifications.

T. Flanged Joints: Not to be used in underground installations except within accessible structures or as shown on Drawings.

U. All pipes, fittings and appurtenances must remain within designated permanent rights-of-way. All construction activities must remain within the right-of-way or temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

V. Embed pipe within 100 feet behind pipe-laying operations, unless otherwise permitted by the Engineer.

W. Do not backfill pipe prior to as-built surveying; refer to Section 02 21 13 - Surveying.

3.6 JOINING FUSIBLE PVC

A. Fusible polyvinyl chloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.

B. If ambient temperature drops below 40 degrees Fahrenheit refer to Underground Solutions Operational Bulletin for Cold Weather Fusion (OB-8-274 012411).

C. Do not perform fusions during adverse weather conditions, including high wind, any amount of blowing dust or precipitation events. Protect exposed pipe faces after facing and surface preparation from blowing dust. Engineer shall have the right to shut down fusing operations if weather conditions are not suitable or if weld quality is suspect. Contractor shall not be entitled to additional compensation for any such additional testing or shut-downs; however, shut-downs required by the Engineer through no fault of the Contractor (i.e. due to weather) shall be considered excused weather delays.

1. In the event of inclement weather, a tent, shelter, or weld screen may be used to protect the fusion environment from dust, precipitation and heater plate variance. Any such enclosures must be approved by the Engineer. Engineer reserves the right to reject such enclosures and shut down operations if the enclosures do not adequately protect the pipe faces or fusion environment.

D. Protect fusible PVC at all times during handling, storage, transport, cutting and fusion from oil contamination.

1. Clean or wipe blades of facing equipment in accordance with equipment manufacturer's recommendations. Unless otherwise indicated by the manufacturer, do not use solvents for cleaning, as these can leave residues that can weaken the fusion joints and cause failures.

E. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

1. Heat Plate – Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.

2. Carriage – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

3. General Machine – Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.

4. Data Logging Device – An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

F. Other equipment specifically required for the fusion process shall include the following:

1. Pipe rollers shall be used for support of pipe to either side of the machine.

2. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.

3. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.

4. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

5. Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

3.7 INSTALLATION - TAPPING SLEEVES AND SADDLES

A. Install tapping sleeves and valves in accordance with Drawings and in accordance with manufacturer's instructions.

B. For dry taps, after drilling into the pipeline, remove all pipe shavings and debris from inside the pipe using a vacuum or other method approved by the Engineer.

C. Do not install tapping sleeves or saddles on fusible or restrained PVC pipe. All taps on fusible or restrained PVC main lines must use MJ reducing tees.

D. Do not allow non-stainless components of tapping saddles or sleeves to come in contact with soil.

1. If any non-stainless part of a tapping saddle or sleeve is installed in contact with soil in a corrosive soil zone, as designated on the Drawings and/or this Section, cathodic protection shall be provided.

3.8 INSTALLATION – BOLTS

A. Apply heavy duty anti-seize to lubricate all stainless steel bolts.

B. Anti-seize compound shall be recommended by manufacturer for use with stainless steel.

3.9 INSTALLATION – STAINLESS STEEL THREADED PIPES AND APPURTENANCES

A. All threaded stainless steel pipes, valves, and fittings shall be wrapped with Teflon graphite tape and/or coated with anti-seize compound approved by manufacturer specifically for use with stainless steel threads.

3.10 THRUST RESTRAINT

A. All restrained PVC pipe joints shall consist of fusible PVC. Bell restraint harnesses are not allowed.

B. Install restrained fittings in accordance with Drawings and in accordance with manufacturer's instruction.

C. Joint restraint lengths:

1. Minimum joint restraint lengths shall be as provided in the Drawings for each appurtenance.

2. For adjacent appurtenances where the required joint restraint lengths overlap each other, refer to the Plans for total required restraint length. In the event of adjacent fitting restraints that are not noted in Plans, consult the Engineer for required restraint length.

3. Lengths of pipe not in contact with soil (i.e. inside casings) shall not be counted toward the restraint length requirement.

D. All thrust blocks shall bear against undisturbed earth.

3.11 BACKFILLING

A. In accordance with Section 31 23 23.

3.12 INSTALLATION – CORROSION PROTECTION AND MONITORING SYSTEMS

A. Design, install, energize, adjust and test sacrificial anode cathodic protection systems and corrosion monitoring stations for all buried ferrous pipe, valves and fittings within the following designated corrosive soil zones:

Navajo Gallup Water Supply Project Reach 10.1			
Affected Area		Min. Apparent Resistivity (ohm-m)	Max. Apparent Resistivity (ohm-m)
Begin Station	End Station		
54+00	123+00	7.90	24.35
171+00	315+00	7.35	28.23
339+00	363+00	8.69	14.64
529+50	565+00	17.14	23.21

Navajo Gallup Water Supply Project Reach 10.2			
Affected Area		Min. Apparent Resistivity (ohm-m)	Max. Apparent Resistivity (ohm-m)
Begin Station	End Station		
Pumping Plant 12	24+21	16.56	32.20
120+60	142+22	13.63	13.95
174+50	185+15	9.55	9.55
239+66	249+04	12.58	12.58
382+67	398+60	12.23	26.08

Navajo Gallup Water Supply Project Reach 10.3			
Affected Area		Min. Apparent Resistivity (ohm-m)	Max. Apparent Resistivity (ohm-m)
Begin Station	End Station		
27+30	81+14	4.20	27.55
146+05	156+86	18.59	18.59
383+61	Nahodishgish Tank	22.78	22.78

B. All buried ferrous pipe, whether cathodically protected or not, shall be provided with corrosion monitoring systems, consisting at a minimum of joint bonding of all non-welded joints between sections of ferrous pipe and adjacent valves and fittings, and two-cable corrosion monitoring stations. Corrosion monitoring systems shall be designed by a NACE-certified Cathodic Protection Specialist.

1. Buried ferrous valves that are not connected to ferrous pipe and that are not located within corrosive soil zones, do not require corrosion monitoring, provided such valves and fittings are coated with fusion bonded-epoxy.

2. Ferrous pipe sections at drain outfalls which are connected to PVC pipe do not require corrosion monitoring.

C. Bury cable to a minimum depth of 36 inches. Install without kinks, stresses, defects, nicks or splices. Install any above grade cables in rigid galvanized steel conduit.

D. Bury warning tape approximately 12 inches above cable for the entire length of cable.

E. Connect cables to test station with crimped, ring-tongue connectors. Identify the origin of all cables terminating in test stations or anode boxes with labels encased in shrink wrap tubing.

F. Install anodes at depth and distance from protected structure in accordance with design provided by NACE-certified designer. Bed anodes in compacted native soil and soak with water. Do not soak with water until after bedding of the anode and compaction of the soil.

G. Joint bonds:

1. Provide metallurgical bonds at non-welded joints between pipe sections, valves or other ferrous components.
2. Minimum of two bonds per joint.
3. Allow for total joint displacement of ½ inch.

H. Welds:

1. Prepare surfaces and perform thermite "cad" welds in accordance with NACE-certified designer's and manufacturer's instructions.
2. Connections shall be placed a minimum of 3 inches apart. Unsuccessful welds shall be abandoned, with original coating repaired, and moved to another prepared surface not less than 3 inches away.
3. Test by striking side of weld nugget with 16-ounce hammer.
4. Coat any bare copper, weld nugget or ferrous material with at least 8 mils of bituminous industrial grade primer. Allow coating to cure before repairing any damaged coatings.
5. Apply thermite weld caps to finished welds.
6. Repair any damaged coatings to original condition.

I. Test Stations:

1. Install at all cathodically protected steel piping, valves and fittings.
2. Terminate all cables for a given location within the same test station enclosure.
3. Identify all cables as to the originating pipe or structure.
4. Contain minimum of three cables for carrying current from the anode, carrying current to protected structure and monitoring soil-to-structure potential.
5. For single anode installations, connect individual anodes to structure through calibrated shunts.
6. For multiple anode installations, a cable between the test station and an anode junction box may be used to connect the anode to the structure.
    a. Connect individual anodes to structures through individual calibrated shunts within junction boxes for current measurement.
    b. Install individual variable resistors in series with these calibrated shunts.
    c. Install junction boxes adjacent to and below test stations where required.
7. Install flush-to-grade test stations flush to finished grade with 24"x24"x6" reinforced concrete collars, etched with "CP test station".

8. Mount anode terminal boxes to inside wall of structures.

J. Electrically isolate all cathodically protected structures from rebar or other non-protected and extraneous metal.

3.13 RESTRICTED AND CULTURALLY SENSITIVE AREAS

A. The designated "Culturally Sensitive Areas" denoted on the Drawings are the basis of establishing where necessary monitoring will take place and the appropriate level of mitigation. Contractor shall notify the Engineer at least 5 working days prior to any ground disturbing activity within 100 feet of any restricted area as designated on the Drawings to allow time for barricades to be denoted and/or a permitted archaeological monitor to be scheduled on-site. Contractor must allow archaeologist and/or Owner's representative to have access to the project site for examination of cultural resources. Contractor must allow archaeologist and/or Owner's representative to halt work, as necessary, to examine cultural resources in spoils and/or trenches. If an any previously unidentified historic or prehistoric cultural resources are discovered, then all work within 100 feet of the discovery will be suspended and the discovery promptly reported to the Engineer and the appropriate agency Navajo Nation Historic Preservation Department (for Navajo lands). If the discovery is evaluated as being significant, treatment of the discovery may be required prior to allowing the project to proceed. Further damage to significant cultural resources will not be allowed until any required treatment is completed.

B. After Owner's Archeologist marks culturally sensitive areas, the Contractor is responsible for constructing temporary fencing with orange net fencing to block areas from inadvertent travel.

3.14 PIPELINE RIGHT-OF-WAY GRADING

A. Mound spoils over pipe as indicated on Drawings. Provide a level 5 ft break in earthen mound every 50 ft to prevent surface runoff from accumulating on the uphill side of the mound.

B. Establish finished grade to provide a minimum of four (4) foot of cover over the pipe. Measure depth of cover from final surface grade to top of pipe barrel.

1. At certain locations, such as wash crossings, road crossings, utility line crossings or to prevent high points, the Drawings indicate greater than 4 ft minimum cover. At such locations, Contractor shall maintain the site-specific minimum cover.

C. Do not place fill material or raise the finished grade above existing grade in the flow lines of washes or surface water drainages, regardless of size.

D. Finished grade along pipeline right-of-way and temporary construction easement shall have a maximum longitudinal slope of 4:1 and maximum side slope of 4:1, unless otherwise noted on Drawings.

E. The pipeline right-of-way shall be leveled from side-to-side to slow down surface run-off from causing erosion rills perpendicular to the pipeline, as well as to make the ROW accessible to the Owner for future maintenance.

1. The entire right-of-way shall be re-seeded and reclaimed after construction. Do not build any new roads. Refer to Section 32 92 19 – Seeding for re-seeding requirements.

2. The right-of-way shall not be open to the general public and shall have minimal impact on the environment. Upon completion of construction, the right-of-way shall be reclaimed to visually blend in with the surrounding environment and minimize its visual impact.

F. All construction activities, including clearing and grading, must remain within the designated right-of-way and temporary construction easement. Do not encroach on adjacent properties or culturally sensitive areas.

3.15 TAPPING EXISTING WATER DISTRIBUTION FACILITIES

A. Obtain permission to tap from the Navajo Tribal Utility Authority (NTUA). A blank Permission to Tap application form is provided in the Contract Documents. Contractor shall not connect to existing system without written permission from NTUA and the Engineer to proceed with connection to the existing system.

B. Obtain permission to tap from Bureau of Reclamation prior to connection to the NGWSP Reach 9 tie-in.

C. Obtain permission to tap from owner prior to tapping Reach 10.1's Pumping Plant 12 Forebay Tanks and before connection to BBN9 Reach 10.2.1.

D. Obtain permission to tap from owner prior to tapping Reach 10.3.

E. Obtain permission to tap from owner prior to tapping the NTUA Nahodishgish Tank.

F. Coordinate with NTUA's designated representative regarding schedule, means and methods, maximum allowable shut-off time, water usage rates (both gpm and gpd) and other parameters stipulated by NTUA.

G. Contractor is advised that a Water Use Permit from Navajo Nation Water Code Administration is required for use of the NTUA water. Contact Monte Chee at (505) 786 – 2395 or mchee_71@yahoo.com for more information.

H. Perform all work in conformance with the tapping permit and all written and verbal instructions from NTUA personnel, including notification and coordination with NTUA, maximum water usage rates, time and duration of shut-offs, and disinfection requirements.

I. Minimize shut-off time during connections to existing facilities. Contractor shall have all tools and materials for actual field conditions as well as foreseeable problems on hand in order to minimize shut-off time.

J. Prevent contamination of existing facilities with trench water, mud, debris, chemicals or other substances.

K. All new materials shall be thoroughly cleaned and disinfected with a strong (50 ppm) chlorine solution prior to connecting to existing NTUA facilities.

3.16 INITIAL FILLING OF PIPELINE

A. "Initial filling" refers to first introduction of water and evacuation of air in the pipeline.

B. Initial filling of pipeline shall not exceed maximum instantaneous flow rate (in gpm) or maximum daily fill rate (in gpd) set forth by NTUA and the Engineer in the field.

C. Unless otherwise directed by the Engineer, the maximum allowable instantaneous flow rate shall be 550 gpm. Note that actual allowable maximum fill rate based on availability of water from NTUA's existing facilities may be significantly less than this amount.

Contractor shall schedule sufficient time for filling and flushing to account for actual water availability from NTUA.

3.17 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.18 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. The Subcontractor shall be required to hydrostatic pressure test all water mains, appurtenances and plumbing trains.

1. Notify Bureau of Reclamation and NTUA 7 days before applying pressure to pipeline.
2. Do not perform leak tests when water is ponded on ground surface from major rain or snow storm, unless approved by Engineer.
3. Conduct hydrostatic pressure testing with potable water.
4. Vent all air from the pipeline prior to pressurization.
5. Fully restrain the pipeline, including permanently installed items and any temporary appurtenances used for testing, prior to pressurization.
6. Perform testing in accordance with applicable standards:
   a. Test pressure: In accordance with the Reach 10.1, Reach 10.2 and Reach 10.3 Hydrostatic Pressure and Leakage Test Calculations provided in the Contract Documents.
   b. PVC pipe: Simultaneous hydrostatic pressure and leakage test. The system shall be pressure tested in-ground in accordance with AWWA C605 and M23, with the exceptions noted below:
      1) Test duration: 2 hours minimum.
         a) Engineer may require longer duration test (up to 24 hours) if there is any doubt as to integrity of a particular section of pipe or appurtenances.
   c. Ductile iron pipe: AWWA C600
   d. Steel pipe: AWWA C200
7. In no case shall the test pressure exceed the manufacturers' recommended maximum safe test pressure for the pipe, fittings or appurtenances.
8. No observable leakage is allowed, if leakage is detected halt test. Measurable leakage must be within the maximum allowable limits set forth by applicable AWWA and ASTM standards including AWWA C605 Sec. 10.3.6 and as presented in the Reach 10.1, Reach 10.2 and Reach 10.3 Hydrostatic Pressure and Leakage Test Calculations.
9. Any leaks detected during testing shall be repaired after pipe is depressurized. After repairs are completed, another full duration test shall be performed on the section of the pipeline to which the repairs were made.

10. All hydrostatic pressure tests must be witnessed by NTUA personnel. Contractor is responsible for coordination of testing schedule with NTUA to allow NTUA's representative to be present.

11. Repeat test until acceptance criteria is achieved.

C. Qualifications of fusible PVC fusion personnel:

1. All fusion technicians shall be fully qualified by the pipe supplier to install fusible polyvinyl chloride pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

2. The entity certifying an operator's qualifications shall retain the ability to revoke an operator's qualification if it is determined that there is a specific reason to question the operator's ability to make joints that meet project specifications.

D. Fusible PVC pipe fusion monitoring and recording:

1. All fusible PVC pipe fusion machines shall be equipped with data loggers connected to the fusion machine to record, at a minimum, joint temperature, pressure, time, and any other parameters required by the pipe supplier.

2. Data loggers shall be used during all joint fusions.

3. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

4. Provide fusion documentation to the Engineer. Documentation shall contain, at a minimum, the following information for every individual fusion:

   a. Data logger device reports

   b. Pipe Size and Thickness

   c. Machine Size

   d. Fusion Technician Identification

   e. Job Identification

   f. Fusion Joint Number

   g. Fusion, Heating, and Drag Pressure Settings

   h. Heat Plate Temperature

   i. Time Stamp

   j. Heating and Cool Down Time of Fusion

   k. Ambient Temperature

5. Contractor shall submit fusion documentation to the Engineer at least weekly while pipe fusing is taking place. Contractor shall not bury any fused pipe until the documentation on the fusion has been reviewed and approved by the Engineer.

   a. Any fusion that is buried prior to Engineer's review and is subsequently rejected shall be removed at Contractor's sole expense.

   b. All fusion documentation shall be reviewed and approved by the pipe supplier's quality assurance manager prior to, or concurrent with, submittal to the Engineer.

E. Fusion Quality Testing on fusible PVC pipe: The Contractor shall verify field fusion quality by making and testing a trial fusion as follows:

1. Frequency: Minimum of one trial fusion with destructive test per crew or per fusion machine, whichever is greater, prior to starting production. Changes in weather, including increase in wind velocity or blowing dust, precipitation events or severe changes in temperature, changes to fusion machine, or changes in fusion personnel may require additional tests, up to a maximum of 5% of welds, at the discretion of the Engineer.

2. Procedure: The trial fusion shall be allowed to cool completely; then test coupons shall be cut out and tested in using the Standard Test Method for Tensile Properties of Plastics in accordance with ASTM D638, with the following modification: The sample coupon shall be the full wall and fusion bead thickness, rather than be machined down to the maximum thickness specified by ASTM D638.

    a. For convenience, Contractor may use other, non-ASTM field tests to gather immediate general information regarding weld quality; however, such tests shall not replace the ASTM D638 test. Only the ASTM D638 test shall be used by the Engineer as a basis of whether to accept or reject any destructively tested fusion joints.

F. Rejection of fusible PVC fusion joints:

1. Engineer reserves the right to reject, or require destructive testing on, any joint that does not meet pipe supplier's recommended fusion parameters, as evidenced by the fusion machine data log.

2. Engineer reserves the right to reject, or require destructive testing on, any joint for which adequate fusion data is not available to verify that the fusion was performed properly.

3. If any tested joint fails the laboratory test, all field fusions represented by that joint shall be rejected.

    a. Any joint that exhibits a yield point less than 95% of that of the unfused pipe or that fails in a brittle mode shall be considered to have failed the tensile test.

4. The Contractor shall make all necessary corrections to equipment, set-up, operation, and fusion procedure, and shall re-make the rejected fusions, at no additional cost to the Owner.

5. In the event that a rejected joint is already installed, the Contractor shall remove, re-fuse, and re-install all pipe represented by that joint at no additional cost to the Owner.

G. Testing of field welds on steel pipe and fittings shall be by ultrasonic or radiographic method in accordance with AWS D1.1.

1. The Engineer reserves the right to demand evidence of welder's certification for all personnel performing field welding of steel pipe and fittings.

H. Thermal contraction and expansion of fusible PVC pipe:

1. Engineer reserves the right to unbolt any flange or mechanical joint attached to fusible PVC pipe (including all butterfly valve assemblies) to check for tensile or compressive loading due to thermal contraction or expansion of the fusible PVC pipe. Excessive tension, indicated by pull-back of the fusible PVC end, or excessive

compression of the flange shall be cause for the Contractor to excavate the fusible pipe, lengthen or shorten the pipe as necessary, and re-bury. Refer to Section 33 12 16 – Water Utility Valves.

I. Compaction Testing: Refer to Section 31 23 23 – Backfill.

J. Testing of cathodic protection systems in accordance with NACE SP-0169. Provide report on test methods utilized and results of tests conducted, as well as as-built drawings with list of anode locations.

K. Test electrical isolation kits for cathodic protection isolation using radio frequency isolation test device both prior to burial and after burial. Test in the presence of the Engineer.

L. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project. All breaks in continuity shall be corrected.

M. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no additional cost to the Owner.

3.19 TOLERANCES

A. Line and grade surveying tolerances:

1. See Section 02 21 13 – Surveying.

B. Flange alignment tolerances as specified in AWWA C207 and AWWA M11.

END OF SECTION

SECTION 33 12 15

WATER SURGE CONTROL TANKS

PART 1 GENERAL

1.1 SUMMARY

A. General

1. The BBN9 Reaches 10.1, 10.2 & 10.3 Project includes three (3) hydropneumatic surge tanks. The surge tanks are located at the Reach 10.1 Surge Tank site, Pumping Plant 12 (PP12) and Pumping Plant 13 (PP13).

B. Section Includes:

1. Furnishing of all equipment, materials, and labor to provide, install and test horizontal bladder-type surge tanks for potable water surge control as shown on the Drawings and specified in these Contract Documents.

C. Related Sections:

1. Section 26 27 34 – Surge Tank Building Instrumentation and Control Requirements
2. Section 33 11 13 - Public Water Transmission Systems.
3. Section 33 12 16 - Water Utility Valves.
4. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Surge Tanks:

1. Basis of Measurement: By the unit.
2. Basis of Payment: Includes connection to main line, surge tank, supports, anchor bolts, structure, electrical connections and appurtenances, rubber expansion joints, fittings and accessories.

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. American Society for Testing and Materials International (ASTM):

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).

C. American Water Works Association (AWWA):

1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1,219 mm), for Water.
3. AWWA C111 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
6. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
7. AWWA C200 - Steel Water Pipe 6 In. (150 mm) and Larger.
8. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.
9. AWWA C206 - Field Welding of Steel Water Pipe.
10. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
11. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
12. AWWA C209 – Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines
13. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
14. AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.
15. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
16. AWWA C606 - Grooved and Shouldered Joints.

D. Manufacturer’s Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

E. National Fire Protection Agency

1. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, and accessories.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Layout drawings shall be submitted and include the dimensions of all equipment, accessories, supports, connections, outlets, and all related piping.

E. Equipment weights and anchor bolt designs.

F. Manufacturer shall perform transient surge analysis for each tank based upon the specific design parameters and provide a complete report in the submittal package.

G. Prior to construction of Surge Tank building foundation and tank pedestals, Contractor shall take actual field measurements of the Surge Tank, and verify that dimensions are compatible with building foundation and tank pedestals per the Construction Drawings. Submit all measurements to Engineer. Based upon said measurements, submit any proposed changes to the building foundation and tank pedestals for Engineer approval.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the most recent edition of New Mexico Standard Specifications for Public Works Construction, with latest revisions.

B. Surge Tanks:

1. The manufacturer of the surge tanks shall be ISO-9001 certified. Vessel manufacturer shall manufacture their own vessels and bladders within the same plant as per quality control through ISO.

2. Manufacturer shall provide in-house x-rays of welds if required by ASME Code. The Engineer reserves the right to inspect the vessel manufacturing facility to confirm requirement above.

PART 2 PRODUCTS

2.1 SURGE TANKS

A. Manufacturers:

1. Charlatte America,

2. Substitutions: Not permitted.

B. The tank shall be a horizontal, bladder-type vessel suitable for use with potable water.

C. The sizing and location of the surge bladder tanks shall be as indicated on the Drawings.

D. Surge Tank Service Conditions and Performance Requirements:

E. Service Conditions:

1. Reach 10.1 Surge Tank

a. Tank hydraulic performance conditions and design data shall be as shown below. In the event that the manufacturer’s hydraulic analysis of

the system yields varying design requirements, the Engineer must be contacted prior to tank fabrication.

b. Surge Tank:

1)	Model Number:	HCA-1057G-H-235/352-47-8
2)	Tank Configuration:	Horizontal
3)	Minimum Capacity:	1057 Gallons
4)	Diameter:	47 inch (approx.)
5)	Overall Length:	150 inch (approx.)
6)	Working Pressure Rating:	235 psi
7)	Test Pressure:	352 psi
8)	Bladder Material:	Food Quality Butyl Rubber
9)	Precharge Pressure Setting:	9 psi to be confirmed by Charlatte during transient analysis review.
10)	Outlet Flange Size:	8 inch
11)	Outlet Pressure Rating:	Class 150 per ANSI B16.5
12)	Minimum Manhole Size:	20 inch

c. Manufacturer shall perform transient surge analysis and provide a complete report. Report details shall include maximum upsurge and downsurge transient pressures as well as required vessel precharge pressures. In no case shall the maximum upsurge pressure exceed 235 psi at the surge tank inlet, nor more than 376 psi at the highest pressure point along the pipeline. In no case shall the minimum downsurge pressure be less than 0 psi anywhere along the pipeline.

2. Pumping Plant 12

a. Tank hydraulic performance conditions and design data shall be as shown below. In the event that the manufacturer's hydraulic analysis of the system yields varying design requirements, the Engineer must be contacted prior to tank fabrication.

b. Surge Tank:

1)	Model Number:	HCA-5811G-H-261/392-83-16
2)	Tank Configuration:	Horizontal
3)	Minimum Capacity:	5811 Gallons
4)	Diameter	83 inch (approx.)
5)	Overall Length	280 inch (approx.)
6)	Working Pressure Rating:	261 psi
7)	Test Pressure:	392 psi

8)	Bladder Material:	Food Quality Butyl Rubber
9)	Precharge Pressure Setting:	132 psi
10)	Outlet Flange Size:	16 inch
11)	Outlet Pressure Rating:	Class 250/300 per ASME/ANSI B16.5
12)	Minimum Manhole Size:	24 inch

c. Manufacturer shall perform transient surge analysis and provide a complete report. Transient Report details shall include maximum upsurge and downsurge transient pressures as well as required vessel precharge pressures. In no case shall the maximum upsurge pressure exceed 261 psi at the surge tank inlet, nor more than 488 psi in the DR14 section of the pipeline, nor 376 psi in the DR18 section of the pipeline, and no more than 320 psi in the DR21 section of the pipeline. In no case shall the minimum downsurge pressure be less than 5 psi anywhere along the pipeline.

3. Pumping Plant 13

a. Tank hydraulic performance conditions and design data shall be as shown below. In the event that the manufacturer's hydraulic analysis of the system yields varying design requirements, the Engineer must be contacted prior to tank fabrication.

b. Surge Tank:

1)	Model Number:	HCA-3170G-H-310/465-75-16
2)	Tank Configuration:	Horizontal
3)	Minimum Capacity:	3170 Gallons (approx.)
4)	Diameter	75 inch (approx.)
5)	Overall Length	189 inch (approx.)
6)	Working Pressure Rating:	310 psi
7)	Test Pressure:	465 psi
8)	Bladder Material:	Food Quality Butyl Rubber
9)	Precharge Pressure Setting:	130 psi to be confirmed by Charlatte during transient analysis review.
10)	Outlet Flange Size:	16 inch
11)	Outlet Pressure Rating:	Class 250/300 per ASME/ANSI B16.5
12)	Minimum Manhole Size:	24 inch

c. Manufacturer shall perform transient surge analysis and provide a complete report. Report details shall include maximum upsurge and downsurge transient pressures as well as required vessel precharge

pressures. In no case shall the maximum upsurge pressure exceed 310 psi at the surge tank inlet, nor more than 488 psi in the DR14 section of the pipeline, 376 psi in the DR18 section of the pipeline, and 320 psi in the DR21 section of the pipeline. In no case shall the minimum downsurge pressure be less than 5 psi anywhere along the pipeline.

F. Structural Design and Supports shall include the tank, supports, and anchor bolts shall be designed based upon local building codes in addition to the following criteria:

1. Design for a hydrostatic operating pressure of:

   a. Reach 10.1 Surge Tank: 235 psi and a test pressure of 352 psi with no reactive load permitted through the inlet/outlet piping.

   b. PP12: 261 psi and a test pressure of 392 psi with no reactive load permitted through the inlet/outlet piping.

   c. PP13: 310 psi and a test pressure of 465 psi with no reactive load permitted through the inlet/outlet piping.

2. Support tank by support legs (four minimum) for attaching to a concrete floor or slab. Material of construction shall comply with ASTM A36 or ASTM A285, Grade C. Weld the support legs to the tank.

3. Seismic Design Parameters to conform to the current IBC for the site location.

G. Surge Tank Design and Materials:

1. Materials for the tank, design, and shop fabrication and inspection shall comply with Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 of said code being used. Provide ASME code stamp, National Board Registration number and pressure rating on tank.

2. Minimum design pressure shall be as stated in this section of the Specifications. Perform hydrostatic testing in shop. Test pressure shall be 150% of the design operating pressure of the tank.

3. The surge tank, bladder and manufacturing facility shall be NFS-61 approved for potable water and listed with NFS.

4. Complete anchor bolt assembly (studs, nuts, washers, etc.) to be provided by Contractor.

5. Bladders and replacement bladders shall be manufactured in the tank manufacturers' plant. Tanks/Vessels shall be fabricated by listed manufacturer, not contracted out.

6. Provide a 1/2-inch threaded connection at the top of the tank to contain a gas charging valve and pressure gauge. Tank shell will be constructed of deep drawn carbon steel double sub-arc welded domes and side shells with double welded seams. Tank shall be equipped with a food grade, heavy duty butyl rubber bladder. The precharge pressure will be located between the shell of the tank and the bladder. The side manhole shall be removable to allow inspection and maintenance of the bladder. The bladder shall be sized to conform to the inner shape of the vessel. Bladder tank shall be of the horizontal configuration.

7. Bladder tank shall be National Board approved with ASME Liquid Relief Valve set at 10% above the operating pressure. Kunkle pressure safety valve to be installed on a ½" NPT side outlet at the bottom of the vessel.

8. Stainless steel magnetic level gauge. No glass level indicators shall be allowed. Level gauge shall be supplied with manual isolation ball valves on the air side & water side connections as well as the drain. In addition, 120 vac solenoid valves shall be provided at all three locations on each tank. A solenoid timer control panel shall be field wired by the Contractor to each of the three solenoid valves. All wiring shall be overhead; do not create any tripping hazards. Timer shall have a single green button which when depressed will start an automatic timing sequence to open the air & water connection solenoid valves for an adjustable period-of-time to allow the magnetic float to reach a steady state level. Then the air & water connection solenoid valves will be closed and a green light indicating the reading is ready shall be illuminated. Finally, the drain solenoid valve shall open to empty the level gauge.

9. One differential pressure transducer shall be provided for each tank and shall be Rosemount Model 3051L 2" ANSI Class 250/300, 316 SST flange mounted with capillary tube and ½" NPT connection for vessel air side mounting on top. Also, included shall be a 2" stainless steel ball valve for isolation and stainless steel flange bolt kits with 1/8" EDPM full face gasket. Also included shall be a 1/8" Garlock Ring Gasket between the ball valve and the Rosemount transmitter to protect the diaphragm.

    a. 4-20mA transmitter output.

    b. -250 to 250 inH_20 transmitter pressure range, field calibrated to tank low and high levels.

    c. Provided with LCD display.

10. Expansion Joints

    a. Reach 10.1:
        1) Proco model 231EE-NSF61 expansion joint with stainless steel control rods and backing rings, 8" diameter, 6" neutral compression length shall be supplied with the vessel. Expansion joint assembly shall be manufactured of NSF-61 Approved EPDM and include retaining rings and control rods all rated to 190 psi working pressure.

    b. Pumping Plant 12 and 13:
        1) Proco model EJQ231HP/EE-NSF61 expansion joints, 16" diameter, 8" neutral compression length, shall be supplied with the vessel. Expansion joint assembly shall be manufactured of NSF-61 Approved EPDM and include retaining rings and limit rods (8) all rated to
        2) Pressure Ratings:
            a) Pumping Plant 12: 261 psi working pressure
            b) Pumping Plant 13: 310 psi working pressure

c. Expansion joints will be mounted directly to vessel outlet flange and shall be sized accordingly. Mounting bolt heads shall be towards the center of the expansion joint with threaded end facing the ends to prevent contact between bolt and joint during pressurization.

11. An additional 2" ANSI Class 150 flanged connection shall be provided as a side outlet for tank drain. Also, provided shall be another 2" stainless steel ball valve for isolation with blind flange and stainless steel flange bolt kits with 1/8" EDPM full face rubber gasket.

H. Painting and Coating:

1. All painting and coating shall be completed at the factory. Field painting and coating will not be accepted. The tank interior shall be painted with an NSF 61 epoxy paint with a uniform layer thickness of no less than 6 mils. The tank exterior shall be painted with anti-corrosion polyurethane and shall have a uniform layer with a minimum thickness of 10 mils.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 INSTALLATION - SURGE TANKS

A. Contractor shall coordinate with surge tank supplier and make measurements of actual surge tank dimensions and pipe connection locations prior to constructing foundation or installing yard pipe risers. Contractor is wholly responsible to align foundations, piping and any other connections with surge tanks in the field.

B. The tank shall be installed in accordance with the manufacturer's recommended procedures.

C. Proco joint compression shall be within manufacturer's recommended tolerances.

1. Do not allow bolts to make contact with rubber joint.

2. Mounting bolt heads shall be towards the center of the expansion joint with threaded end facing the ends to prevent contact between bolt and joint during pressurization.

3. Field verify laying length and control bolt lengths before foundation construction.

D. Pre-charge of tanks shall be performed by an authorized factory representative or employee of the manufacturer.

E. Contractor shall isolate surge tank from main line until main line flushing is completed, in order, to keep debris out of surge tank. This shall be accomplished by installing a blind flange on the riser pipe, which will be removed after the main line is flushed.

3.3 DISINFECTION OF POTABLE WATER PIPING SYSTEM (BY CONTRACTOR)

A. Flush and disinfect system in accordance with Section 33 13 00.

3.4 START-UP SERVICES

A. Provide at least one full 8-hour day of service from manufacturer's representative to approve the tank installation and advise the Contractor during startup, testing, and final adjustment of each tank. In addition to this day, one additional full 8-hour day shall be provided in a separate trip to instruct the Owner's personnel in the operation and maintenance of the tank system.

B. Contractor shall coordinate with both surge tank manufacturer's representative and pump station manufacturer's representative to schedule start-up, and allow for simultaneous start-up and testing of both pieces of equipment.

C. Perform quality control testing, as described below, during start-up.

3.5 FIELD QUALITY CONTROL

A. Test all air lines and fittings for leaks.

B. Test all water level indicators, gauges, and pressure transducers.

C. Verify pre-charge, static, and dynamic working pressures are all within manufacturer's recommended ranges.

1. Dynamic working pressures must be tested during pump station startup, with pumps running.

D. Verify tank water levels under static, dynamic, and transient conditions are all within manufacturer's recommended ranges.

1. Transient water levels shall be tested during pump station start-up by running pumps to full operating speed and performing an emergency sudden shut-down to simulate pump power failure. Surge tank water levels shall not exceed manufacturer's recommended ranges under these conditions.

END OF SECTION

SECTION 33 12 16

WATER UTILITY VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gate Valves.
2. Butterfly Valves
3. Ball Valves
4. Orifice Plates.
5. Air Valves.
6. Inflow Preventor
7. Dismantling Joints
8. Flush Valve Assemblies.
9. Valve boxes.
10. Meter cans & pits.
11. Pipe Supports
12. Valve vaults.
13. Accessories.
14. Corrosion Protection.
15. Valves used in Chlorination Building
    a. Refer to Section 22 11 05 – Chlorination Facility Plumbing for valves used in this facility.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 31 22 13 - Rough Grading.
3. Section 31 23 23 - Backfill.
4. Section 33 11 13 - Public Water Transmission Systems.
5. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Vacuum Breaker and Air Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment: Includes excavation, vacuum breaker / air valve assembly, meter pit, cover and hatch, identification placards, warning tags, fittings, accessories and backfill.

B. Main Line Butterfly Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment: Includes excavation, main line butterfly valves, actuator, by-pass valves, by-pass piping, orifice plates, adaptors, fittings, valve boxes, lids, meter cans, collars, collar warning placards, warning placards, accessories, and backfill.

C. Main Line Gate Valve with Reducer Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment: Includes excavation, main line gate valves, reducers, adaptors, fittings, valve boxes, lids, meter cans, collars, warning placards, collar warning placards, accessories, and backfill.

D. Site Butterfly Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment: Includes excavation, butterfly valves, actuator, adaptors, fittings, valve boxes, lids, meter cans, collars, identification placards, collar warning placards, warning placards, collars, accessories, and backfill.

E. Site Gate Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment: Includes excavation, gate valves, adaptors, fittings, valve boxes, lids, identification placards, collar warning placards, warning placards, collars, accessories, and backfill.

F. Flush Valve Assemblies:

1. Basis of Measurement: Each.

2. Basis of Payment:

a. 4-inch Flush valve with above grade discharge: Includes excavation, 4-inch piping, orifice plate, collar warning placards, collars, above-grade discharge pipe, gravel pack at weep hole, valve box and riser (where applicable), accessories and backfill.

b. 4-inch Flush valve with wash outfall (if applicable): Includes excavation, 4-inch piping, 4-inch gate valve assembly as shown on plans, drain line, orifice plate (where applicable), collar warning placards, collars, cast iron flap valve, outfall structure, fittings, valve box and riser (where applicable), accessories and backfill.

G. Cathodic Protection:

1. Refer to Section 33 11 13

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M 306-10 - Standard Specification for Drainage, Sewer, Utility and Related Castings

B. ASTM International (ASTM)

1. ASTM A48 – Standard Specification for Gray Iron Castings
2. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. ASTM A536 – Standard Specification for Ductile Iron Castings
4. ASTM A564 – Standard Specification for Hot Rolled and Cold Finished Age Hardening Stainless Steel Bars and Shapes
5. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings
6. ASTM B148 – Standard Specification for Aluminum Bronze Sand Castings
7. ASTM C478 – Circular Precast Reinforced Concrete Manhole Sections
8. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
9. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
10. ASTM F594 – Standard Specification for Stainless Steel Nuts.
11. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe
12. ASTM D3363 – Standard Test Method for Film Hardness by Pencil Test
13. ASTM D4752 – Standard Practice for Measuring MEK Resistance of Ethyl Silicate Zinc Rich Primers by Solvent Rub
14. ASTM D638 – Standard Test Method for Tensile Properties of Plastics

C. American Water Works Association (AWWA):

1. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service
2. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
3. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.
4. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
5. AWWA M11 – Steel Pipe: A Guide for Design and Installation
6. AWWA M23 – PVC Pipe – Design and Installation

D. American National Standards Institute

1. ANSI B16.1 Gray Iron Pipe Flanges and Flanged Fittings

E. NACE International (NACE)

1. SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.

F. NSF International/ American National Standard (ANSI):

1. NSF/ANSI Standard 61 - Drinking Water Components - Health Effects.

G. Society for Protective Coatings:

1. SSPC-SP1 – Solvent Cleaning
2. SSPC-SP2 – Hand Tool Cleaning

1.4 SUBMITTALS

A. Design Data: Submit manufacturer's latest published literature. Include illustrations, installation instructions, maintenance instructions and parts lists.

B. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

C. Submit proofs on all signs, placards, and tags prior to fabrication.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Provide Operation and Maintenance Data for each type of valve installed.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with applicable New Mexico Standards and the National Fire Protection Act (NFPA).

B. Valves: Mark valve body with manufacturer's name and pressure rating.

1.7 DELIVERY, STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA Standards and seal valve ends to prevent entry of foreign matter into product body.

B. Deliver and store valves in shipping containers with labeling in place.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior and exterior surfaces.

D. Coated valves and appurtenances shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces, and shall be stored on padded skids or other suitable means to prevent damage to coatings.

E. Coated valves shall be handled with wide belt slings, padded forks or other means to prevent damage to coatings. Chains, cables or other equipment likely to damage coatings or valves shall not be used.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 MAINTENANCE MATERIALS

A. Furnish two (2) tee wrenches to Owner (required length) for each valve type.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall be American made, unless otherwise specified.

B. All non-stainless steel and iron valves and appurtenances shall be fusion bonded epoxy coated, interior and exterior, conforming to AWWA C550 and NSF 61.

C. All valves and coatings shall be NSF 61-certified.

D. All bolts, nuts, and washers (where required) shall be stainless steel 304, unless otherwise specified, and shall be provided by the valve or fitting manufacturer especially for use with their respective valves or fittings. If manufacturer cannot supply stainless steel bolts for the MJ or flange connection, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

2.2 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. Mueller Company

a. A-2361

2. Substitutions: Approved Equal

B. Resilient Wedge Gate Valves: AWWA C515, NSF 61, American-made; ductile iron.

1. Resilient seats.

2. Stem: Non-rising bronze stem.

3. Operating Nut: Square; open counterclockwise unless otherwise indicated.

4. Gearing

a. Bevel geared for horizontal installation.

b. Spur geared for vertical installation.

5. Valve Ends:

a. Mechanical joint or flanged or threaded, as indicated on Drawings.

b. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern, unless otherwise noted on Drawings.

c. Pressure rating not less than that of valve body.

6. Working pressure rating: 350 psi.

7. Pressure testing: Seat test – 525 psi for 15 seconds, test seat from each side of valve separately per UL262. Shell test pressure: 700 psi.

8. Inside and outside of valve fully coated with Fusion Bonded Epoxy, 10 mils nominal, conforming to AWWA C550 and NSF 61 requirements.

C. Where waterline is buried at a depth greater than 4 feet, provide valve stem extensions, complete with extension stem stabilizers, until depth of extension nut matches depth of operating nuts on valves installed at four-foot depth.

2.3 BUTTERFLY VALVES

A. Manufacturers:

1. Henry Pratt Co.

a. Groundhog

2. Val-Matic Valve and Manufacturing Corporation

a. Series 2400

3. Substitutions: Not permitted.

B. 250 psi Butterfly Valves:

1. Conforming to AWWA C504, Pressure class AWWA 250B, MSS SP 67 and NSF 61.

2. Rated to 250 psi full differential working pressure.

3. Shell test pressure 500 psi.

4. Leak test at 250 psi.

5. Body: Ductile iron, drilled in accordance with ANSI B16.1 Class 125, stainless steel shaft. Body wall thickness shall be in accordance with AWWA C504.

C. Valve Ends:

1. Mechanical joint or flanged, as indicated on Drawings.

2. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern.

3. Pressure rating not less than that of valve body.

D. Disc: Epoxy-coated cast iron, with stainless steel 316 edge.

E. Seat: Resilient Buna N.

F. Shafts: Shall be sized, designed and constructed in conformance with AWWA C504 for pressure class AWWA 250B. Shafts shall be SS ASTM A-276 Type 304.

G. Handle and Operator:

1. Direct buried service.
2. Manual actuators shall conform to AWWA C504 for pressure class AWWA 250B.
3. Actuators shall be buried service type with square operating nut, shall be of traveling nut, self-locking type able to hold valve in any intermediate position without fluttering or creeping. Actuators shall have external travel stops for open and closed position adjustment. Internal stops which require actuator cover and grease removal shall not be used.
4. Actuator shall have mechanical stops able withstand input torque of 450 ft-lb against each stop.
5. Open left, close right.
6. Buried service actuators shall be grease packed.

H. Slow Close Actuator for 16" Master Isolation Valve at the Reach 10.1 Turnout Beginning of the Line (BOL)

1. Direct buried service with 2" operating nut.
2. Quarter-turn manual gearbox with 360-degree bronze worm wheel.
   a. AUMA GS100.3
   b. Reduction radio: 208:1
   c. Mechanical advantage: 77.0
   d. Swing angle: 92 degrees, adjusted at factory
   e. Turns for 90°: 52
3. Corrosion protection KS with powder coating

I. Slow Close Actuator for 8" Master Isolation Valve at PP12 Tank Site

1. Direct buried service with 2" operating nut.
2. Quarter-turn manual gearbox with 360-degree bronze worm wheel.
   a. AUMA GS100.3
   b. Reduction radio: 160:1
   c. Mechanical advantage: 55.5
   d. Swing angle: 92 degrees, adjusted at factory
   e. Turns for 90°: 40
3. Corrosion protection KS with powder coating

J. Where valve is direct buried at a depth greater than 4 feet, provide valve stem extensions, complete with extension stem stabilizers, until depth of extension nut at least matches depth of operating nuts on valves installed at four-foot depth.

2.4 BALL VALVES

A. Stainless steel ball valves for air and vacuum breaker valve assemblies

1. Size: ¼-inch, ½-inch, 1-inch, 2-inch, or 3-inch, as shown on Drawings
2. Manufacturers:
   a. Milwaukee Valve
   b. Apollo
   c. Approved equal
3. Working Pressure: Not less than 350 psi
4. Inlet/Outlet: FNPT, or as shown on Drawings
5. All stainless steel construction, including body, tailpiece, ball, ball retainer, stem, handle, handle nut, packing nut, and lock washer
6. Valve shall be actuated manually using lever-type handle, one-quarter turn to open and close. Handle length and range of motion shall allow handle to be located in the most accessible location without interference with any other object.

2.5 ORIFICE PLATES

A. Stainless steel 304

B. Thickness 3/8” or as shown on plans

C. Orifice shall be beveled at 45° angle, 3/16” deep on downstream side.

D. Fabrication:

1. Flush Valve Orifice Plates: Orifice plates shall be fabricated and drilled with a single concentric hole of the proper diameter for each installation as indicated on the Drawings. Both faces of the plate shall be machined smooth to remove all burrs, ridges and other imperfection in the flow area. Mating edges shall be machined to the same tolerances as flange mating faces (see Section 33 11 13). The orifice holes shall be machined to a tolerance of +/- 15 mils.
2. Butterfly Valve By-pass Valve Orifice Plates: Orifice plates shall be fabricated and drilled with a multiple holes of the proper diameter for each installation as indicated on the Drawings. Both faces of the plate shall be machined smooth to remove all burrs, ridges and other imperfection in the flow area. Mating edges shall be machined to the same tolerances as flange mating faces (see Section 33 11 13). The orifice holes shall be machined to a tolerance of +/- 15 mils.

2.6 AIR VALVES

A. ½-inch air release valve (pressure transducer vault):

1. Manufacturer:
   a. Val-Matic Valve and Manufacturing Corporation, Model # 15A.SV
   b. Substitutions: Approved Equal
2. Working pressure: 175 psi
3. Inlet: ½” NPT

4. Cast iron or ductile iron body, cover and baffle; stainless steel trim, float, and fasteners.
5. Seat: Resilient Buna N.
6. Internal and external coatings shall be fusion bonded epoxy conforming to NSF-61 requirements.

A. 2-inch vacuum breaker valve with 1-inch air release valve:

1. Manufacturer:
   a. Val-Matic Valve and Manufacturing Corporation. Model 1852VB.3XFSVH/38HPDISVH. Dual-body Type.
   b. Substitutions: Not permitted
2. Working pressure: vacuum breaker valve: 400 psi; Air release valve: 500 psi
3. Vacuum breaker valve inlet: 2", flanged, ANSI Class 250
4. Cast iron or ductile iron body, cover and baffle; stainless steel trim, float, and fasteners.
5. Seat: Resilient Buna N.
6. Valve to perform functions of both air release and vacuum relief.
   a. Vacuum breaker orifice: 2"
   b. Air release orifice: 1/8"
      1) Air release valve to be mounted adjacent to vacuum breaker valve.
7. Stainless steel 304 piping, valve, and fittings between vacuum relief valve and air valve bodies.
8. Internal and external coatings shall be fusion bonded epoxy conforming to NSF-61 requirements.
9. Hood: Valve assembly shall include hood mounted permanently to the valve outlet opening.

2.7 INFLOW PREVENTOR

A. Inflow Preventor for a 2-inch vacuum breaker valve with 1-inch air release valve:

1. Manufacturer
   a. Valmatic Floodsafe Model 1300 Series
2. Female NPT thread
3. Materials
   a. The upper and lower chambers shall be constructed of ASTM A536, Grade 65-45-12 ductile iron.
   b. Float checks and trim shall be constructed of Type 316 stainless steel.

c. Resilient seats shall be EPDM with fiberglass reinforcement.

4. Redundant float actuated closure members.
5. Heavy duty basket type screen.
6. FBE coated wall bracket shall be provided.
7. Stainless steel braided hose to attach to Air Valve.

2.8 DISMANTLING JOINTS

1. Manufacturer:
   a. ROMAC, Model DJ400
   b. Substitutions: Approved Equal
2. Flanges: ANSI Class 150
3. NSF 61 Certified fusion bonded epoxy coating
4. Color: Blue
5. Integral Tie Rods
6. 304 stainless steel fasteners (nuts, bolts, tie-rods)
7. Working pressure: 275 psi

2.9 FLUSH VALVE ASSEMBLIES

A. Components of flush valve assembly shall be as provided elsewhere in project specifications.

B. Cast iron flap valves:
   1. End: Flanged

C. Rubber check valves:
   1. Manufacturers:
      a. Tideflex Series 35
      b. Proco Series 710
      c. Approved Equal
   2. End: Flanged

D. Ductile iron drain pipe sections shall be double-wrapped polyethylene in accordance with AWWA C105, Installation Method “A”.
   1. Inner jacket: V-bio enhanced polyethylene
   2. Outer jacket: standard polyethylene

2.10 VALVE BOXES

A. 12-inch diameter Valves and Smaller: Cast iron, two-piece, slip type.

B. Valves larger than 12-inch diameter: Domestic cast iron, three-piece, slip type; round base.

C. Where waterline is buried at a depth greater than 4 feet, provide valve box extensions as required.

D. Cast iron lid marked “Water”.

E. Heavy duty, traffic rated.

F. Valve boxes with warning placards shall have locking lids with standard pentagon nut.

G. Valve boxes shall include debris caps

1. Manufacturer: SW Services

2. Protects valve from dirt, debris and damage

2.11 METER CANS & PITS

A. Frame and cover for locking valves:

1. Traffic-rated to H20 proof load of 20,000 lbs applied on a 9” x 9” steel plate in center of cover for one minute.

2. Reversible ring, ASTM A48 CL35B gray iron, undipped

a. Shall fit the 18-inch CMP meter can specified below.

b. 15-inch minimum opening size.

3. Cast iron lid shall have non-skid machined surface with "WATER" inscribed on the top.

4. Type 2 Non-penetrating pick hole

5. Pentagon Nut Lockable lid

6. Frost proof design

B. Meter Can for locking valves:

1. 18” inner diameter, 20 gauge corrugated metal pipe, length per detail drawing.

2. Maximum wall deflection shall not exceed $^1/_8$” at any one point when subtracted from earth pressures or forces created during backfilling.

C. Meter Pit for Vacuum Breaker / Air Release Valves:

1. Body material LLDPE

2. 36” inner diameter, 3/8” wall thickness, length per detail drawing.

3. Crush Resistant Ribbing
   a. Maximum wall deflection shall not exceed $^1/_8$” at any one point when subtracted from earth pressures or forces created during backfilling.

4. Contractor responsible to ensure compatibility between meter pit / box, flange, ring, and cover.

D. Frame and cover for Vacuum Breaker / Air Release Valves:

1. Monitor style lid

2. Cast iron lid shall have non-skid machined surface with "WATER" inscribed on the top
3. Ring, ASTM A48 CL35B gray iron, undipped
    a. Shall fit the 36-inch plastic meter pit specified below.
    b. 20-inch minimum opening size.
4. Pentagon Nut Lockable lid
5. Frost proof design with inner frost lid

2.12 PIPE SUPPORTS

A. Manufacturer:
    1. Standon, S92 Series
    2. Substitutions: Approved Equal
B. 304 stainless steel
C. Size per drawings
D. 8”x8”x3/8” thick base plate bolted to chamber floor

2.13 VALVE VAULTS

A. Concrete manhole sections conforming to ASTM C478 and ASTM C857.
    1. Bell and spigot joints.
    2. Symmetrical reinforcement only.
    3. Soil-tight gasket conforming to ASTM C-990.
    4. Embedded ladder rungs.
B. Concrete shall conform to Section 03 30 00 – Cast-in-Place Concrete.
C. Concrete shall be 4000 psi.
D. Manufactured or cut to lengths shown on Drawings.
E. “Mouse hole” or circular cut-outs to accommodate main line pipe inside vaults, if needed, shall be pre-cast.
F. Pre-fabricated reinforced flat, slab-type lids with hinged, lockable hatches as shown on Drawings.
    1. Shallow well manhole covers, where indicated on Drawings, shall be 24” diameter, as provided by Four Corners Precast, OAE.
G. Square access covers:
    1. Manufacturers:
        a. Halliday Products, Series W1S or W2S as shown on drawings
        b. MSU Mississauga Ltd series MD-CL625

c. Substitutions: None

2. Dimensions as shown on Drawings.
3. Load Rating: 300 lbs
4. Gasketed lid with channel system to divert water
5. Assisted opening with slam prevention system
6. Bituminous coating
7. Stainless Steel Hardware
8. Recessed Lockable Hasp and lifting handle

H. Foam insulation.

1. 2” minimum thickness
2. Spray Foam Insulation.
   a. 2-lb closed cell, two-component, rigid polyurethane.
   b. R Value per inch of 6.6 or greater (K factor 0.15 or less).
   c. Suitable for application to low temperature substrates (15°F).
   d. Waterproof mixture in sealant
3. Sheet insulation may be considered by the Engineer as a substitute if demonstrated to meet or exceed the properties of spray foam insulation, including resistance to moisture build up or condensation behind the insulation. The burden to demonstrate the properties of any substitute shall be borne by the Contractor.

I. Two-way draft damper

1. Manufacturers:
   a. Val-Matic, Frost Safe, VM-1504
   b. Substitutions: Approved Equal
2. Field replaceable disc that opens fully to provide full flow area in both directions without requiring annular clearance with the body.
3. Contains no hinges or seats subject to freezing

J. Link Seals

1. Manufacturers:
   a. GPT Industries Link Seal
   b. Substitutions: Approved Equal
2. Type: Stainless
   a. Seal Element: EPDM
   b. Pressure Plates: Reinforced Nylon Polymer
   c. Bolts and Nuts: 316 Stainless Steel

3. Size to ensure water-proof seal

2.14 WARNING PLACARDS FOR GATE VALVE BOX LIDS

A. Rectangular aluminum plate with four pre-drilled holes to accommodate 1/8" diameter ¼" grip stainless steel pop rivets, and 1-7/8" pre-drilled center hole.

1. Contractor responsible to verify diameter of center hole to correspond to outer diameter of key to locking nut of lockable valve box lid.

B. Dimensions: 4½"w x 4½"h x 0.04"t

C. White enamel-coated aluminum placard

D. Printed on 3.75 mil, 5 yr outdoor-rated calendared gloss vinyl with permanent solvent adhesive, printed with ECO-Solvent permanent ink.

E. Laminated with 2.5 mil calendared gloss over-laminate rated for 4 yr outdoor use.

F. White background with red and black lettering as shown on Drawings.

G. Arial font with 0.25" minimum height lettering, or as permitted by placard dimensions and pre-drilled holes.

H. Warning placards shall be affixed to lockable valve box lids with four 1/8" diameter x ¼" grip stainless steel pop rivets.

I. Submit a proof to Engineer for approval before producing placards. Proof shall include placement of placard on the valve box cover to ensure proper fit and clearances.

2.15 VALVE IDENTIFICATION PLACARDS AND COLLAR WARNING PLACARDS (FOR ISOLATION AND FLUSH VALVES AND TRANSDUCER VAULT)

A. Rectangular stainless steel 430 plate with 4 x ¼" pre-drilled holes

B. Dimensions: 8"w x 6"h x 0.029"t or as shown on plans.

C. Laser-etched lettering using Cermak LMM6000 laser marking promoter with 150 watt CO2 laser.

D. Arial font with size as large as permitted by placard dimensions and pre-drilled holes, centered horizontally and vertically on placard; minimum 3/8" letter height.

E. Valve identification placards shall be affixed to concrete with four 3/16" diameter x 1-¼" length concrete screws.

F. Submit a proof to Engineer for approval before producing placards.

2.16 VALVE IDENTIFICATION PLACARDS (FOR AIR VALVES)

A. Rectangular stainless steel 430 plate with 4 x 3/16" pre-drilled holes.

B. Dimensions: 6"w x 6"h x 0.029"t or as shown on plans.

C. Laser-etched lettering using Cermak LMM6000 laser marking promoter with 150 watt CO2 laser.

D. Arial font with size as large as permitted by placard dimensions and pre-drilled holes, centered horizontally and vertically on placard; minimum 3/8" letter height.

E. Valve identification placards shall be affixed with four 1/8" diameter x ¼" grip stainless steel pop rivets.

F. Submit a proof to Engineer for approval before producing placards.

2.17 VALVE IDENTIFICATION TAGS (FOR 2-INCH VACUUM BREAKER VALVES)

A. Identification tag:

1. Stainless steel 304 or 316
2. Natural metal color background with black lettering
3. Dimensions: 2" x 2.5" x 0.024" thick
4. Includes pre-cut hole for fastener. Contractor responsible for assuring pre-cut hole is properly sized for fastener.
5. Laser-etched lettering using Cermak LMM6000 laser marking promoter with 150 watt CO2 laser
6. Minimum letter/font height: 0.1", or larger depending on available printing space for each tag
7. Wording as indicated on drawings.

B. Fastener:

1. Stainless Steel #6 Beaded Chain

C. Submit a proof to Engineer for approval before producing tags.

2.18 ACCESSORIES

A. Concrete for thrust restraints, blocks and collars: Concrete type specified in Section 03 30 00.

2.19 STEEL PIPES AND FITTINGS

A. All steel pipes and fittings shall be Stainless Steel 304, unless otherwise noted.

B. Pressure rating: At least 350 psi Cold Working Pressure, unless otherwise noted.

C. Stainless Steel Annealed tubing may be used.

2.20 STAINLESS STEEL THREAD PROTECTION

A. All stainless steel threads shall be protected with Teflon graphite tape and/or anti-seize compound approved by manufacturer specifically for use with stainless steel threads.

2.21 CORROSION PROTECTION

A. Refer to Section 33 11 13.

2.22 SOURCE QUALITY CONTROL

A. Coatings:

1. Cure testing for fusion bonded or liquid epoxy coatings: ASTM D4752 and ASTM D3363, Every 1000 sq. ft. of epoxy coating.

2. Holiday testing for epoxy coatings:

a. All fusion-bonded epoxy coatings on all valves shall be holiday tested prior to installation, at Contractor's expense.

b. Perform testing in accordance with NACE Standard SP0274, using electrical holiday tester. Use test voltage below:

Total Coating Thickness (Mils)	Test Voltage (Volts)
20 or less	6000
30	7500
50	9000
70	11500
80 or more	12000

c. All holidays shall be repaired and re-tested, at no additional cost to the Owner.

3. Touch up and repair of Fusion Bonded Epoxy Coatings

a. Applies to all FBE coated valves for field repair of minor holidays, scratches, breaks or other damage to FBE coating.

b. Does not include repair or touch up of systemic or large area holidays in FBE coating. Repair of systematic holidays or damaged areas larger than three (3) sq. in. will require the damaged coating be ground off and the valve be newly shop-coated.

c. Materials and application:

1) NSF/ ANSI 61 certified, two-part, 100% solids, liquid epoxy coating meeting the requirements of AWWA C210.

a) Manufacturer: 3M Scotchkote Epoxy Coating 323, OAE.

b) If temperature is below 55 degrees Fahrenheit, the metal substrate shall be pre-heated in accordance with coating manufacturer's recommendations prior to applying the coating.

d. Prepare surface and apply per coating manufacturer's instructions for use as a field repair material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.

B. Verify invert elevations prior to excavation and installation of valves.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission or without making arrangements to provide temporary utility services.

1. Notify Engineer not less than 48 hours in advance of proposed utility interruption.

2. Do not proceed without written permission from the Engineer.

D. Perform trench excavation, backfilling and compaction in accordance with Sections 31 23 17 and 31 23 23.

3.3 INSTALLATION

A. Valve scribing: All valve collars shall be scribed with the valve data.

1. Valve collars shall be etched using a 4-inch grinder, with Engineer's approval in field.

2. All valve collars outside fenced sites ("main line valves") shall be etched with the following valve data:

a. Flow directional arrows

b. Station number in standard "STA XXX+XX" format, including the abbreviation "STA" in front of the number

c. Pipe size (if different from valve size) and material

d. Valve size and type (i.e. ARV, VB, GV, BFV)

e. Number of turns to operate.

3. All valve collars inside fenced areas ("site valves") shall be etched with:

a. Flow direction arrows

b. Valve type

c. Valve size

d. Pipe material

4. All valve collars and vault lids inside fenced areas ("site valves") shall be further labeled with a laser etched 8" x 6" aluminum identification placard, as specified above.

a. Follow anchor manufacturer guidelines for proper installation.

b. Contractor responsible for verifying anchor and anchor head diameters are compatible with holes in aluminum plate.

c. Valve identification placards shall contain the following valve data:

1) Valve number, as provided on site valve numbering plans

2) Valve size

3) Valve type (i.e. BFV, GV, etc.)

4) Description of valve function, as provided on site valve numbering plans

5) Number of turns to operate.

d. Vault identification placards shall contain the data shown on the drawings.

5. All valve collars inside fenced areas ("site valves") and outside fenced sites ("main line valves") shall be further labeled with a laser etched 8" x 6" (or as specified on drawings) aluminum collar warning placard, as specified above.

a. Follow anchor manufacturer guidelines for proper installation.

b. Contractor responsible for verifying anchor and anchor head diameters are compatible with holes in aluminum plate.

c. Valve collar warning placards shall have wording per drawings.

6. Vacuum breaker / ARV valve meter pit lids shall be etched using a 4-inch grinder, as specified above.

a. Follow anchor manufacturer guidelines for proper installation.

b. Contractor responsible for verifying rivet head diameters are compatible with holes in aluminum plate.

c. Valve identification etching shall contain the following valve data:

1) Valve station

2) Valve type (i.e. 2" VB / 1" ARV, etc.)

3) Tapped pipe size and type

7. Contractor shall verify all data on the site valve numbering plans with Engineer prior to scribing of valve collars or fabrication of placards. Contractor shall be responsible for replacement of any incorrect placards or valve collars if this data is not verified by Engineer.

B. Valve box security and warning placards:

1. Affix warning placard, as specified above, to the top of valve box lid at locations indicated on Drawings.

a. Ensure placards centered within valve box lids and center hole aligned with locking nut. Do not allow corners of placard to overhang the lid.

b. Pre-drill holes in valve box lids and install rivets, per manufacturer's instructions. Ensure rivets grip properly into the lid.

2. All valves indicated as requiring warning placards shall be installed below grade inside meter cans, as shown on Drawings.

C. Valve Vaults

1. Thoroughly clean vault section ends with wire brush prior to joining sections.

2. Place vault sections with bell down.

3. Seal all vault sections with sealant approved by Engineer.

4. Grout lids as directed by Engineer.

5. Field apply foam insulation in accordance with manufacturer's instructions and recommendations. Personnel applying spray foam insulation shall be sufficiently trained by the manufacturer, the Center for the Polyurethane Industry, the Spray Polyurethane Foam Alliance, or similarly competent certifying body.

D. Apply heavy duty anti-seize to lubricate all stainless steel bolts. Anti-seize compound shall be recommended by manufacturer for use with stainless steel bolts.

E. Vacuum and Air Valve Assemblies

1. Install in accordance with AWWA standards and manufacturer's recommendations

2. After drilling into the main line, remove all pipe cuttings and other debris with a vacuum or other method approved by the engineer prior to installing the valve assembly.

3. Install vacuum and air valve assemblies in vertical position.

4. Where indicated at high points in pipe on Drawings, install at actual high points, as determined by as-built pipeline survey data.

5. Secure assemblies to Unistruts as shown on Drawings to prevent lateral movement or stresses.

6. Air valve assemblies installed on restrained or fusible PVC main line shall have FBE-coated DI reducing tees in lieu of tapping sleeves. Reducing tees located in corrosive soil zones shall be cathodically protected.

7. Galvanized steel air vents shall be painted blue as follows:

a. Minimum surface preparation: SSPC-SP1

b. Primer: 1 coat Sherwin Williams Galvite HS, OAE

1) 3.0-4.5 mils dry film thickness

c. Finish: Two coats Sherwin Williams Industrial Enamel (B54 Series), OAE

1) 2.0-4.0 mils dry film thickness

d. Follow all other paint manufacturer recommendations for preparation and application.

F. Gate Valves and Butterfly Valves:

1. Install in accordance with AWWA standards and manufacturer's recommendations
2. Install valves in conjunction with pipe laying; set valves plumb.
3. Assemble complete valve assembly and place in open excavation at proper line and grade.
4. All buried flanges shall be wax tape-wrapped in accordance with Section 33 11 13 – Public Water Transmission Systems.
5. Provide buried valves with valve boxes or meter boxes installed as shown on drawings above finished grade.
    a. Any valve box lids, meter can lids, or collars that do not meet grade requirements shown on Drawings shall be removed and replaced.
6. Install valve stem risers, collars and valve box extensions as required to match finished grade.
7. Gate valves and butterfly valves shall require the same joint restraint lengths as dead-ends of similar size and pipe material.

G. Flush Valves:

1. Above grade discharges:
    a. All buried metallic pipes and fittings shall be cold-applied tape-wrapped in accordance with Section 33 11 13 – Public Water Transmission Systems.
    b. Above-ground piping shall be painted blue, in accordance with this Section.

H. Assemble steel flanged joints in accordance with AWWA M11 and AWWA C207.

I. No high points in the pipe of any magnitude shall be allowed without an appropriate vacuum/ air valve. If the As-Built survey of the pipeline reveals high points not shown on the Drawings, Contractor shall correct the pipe grade or install additional air valves, as directed by Engineer.

1. Additional air valves required due to unforeseen field conditions not the fault of the Contractor shall be paid for at the prices established in the Bid. Contractor shall promptly report such conditions to the Engineer.
2. Additional air valves required due to high points caused through fault of the Contractor shall be provided at no additional cost to the Owner. This includes failure of Contractor to meet lines and grades set forth in the Drawings or failure to meet minimum pipe slope.
    a. If the required air valve is located on a fusible or restrained section of main line, a reducing tee is required in lieu of tapping sleeve.
    b. If a reducing tee is required within a corrosive soil zone, Contractor shall provide cathodic protection for the tee at no additional cost to the Owner.

3. Engineer shall determine which type of air valve is required at a given location.

J. Tracer wire:

1. For direct buried valves with surface valve box lids, tape tracer wire to outside of valve box up to last section of box. Bring tracer wire into the valve box above the operating nut. Coil 18" tracer wire inside valve box under the lid.

2. For direct buried valves with valve box lids inside meter cans, bring tracer wire into the meter can outside of the valve box. Coil 18" tracer wire inside meter can.

3. For all valve vaults, coil min. 24" tracer wire against wall on each side of vault.

K. All shallow well manhole covers, valve box lids, meter can lids, and other cast iron appurtenances visible from surface shall be painted blue as follows.

1. Minimum surface preparation: SSPC-SP2

2. Primer: Sherwin Williams Kem Kromik Universal Metal Primer, OAE

a. One coat, 3.0-4.0 mils dry film thickness

3. Finish: Sherwin Williams Industrial Enamel (B54 Series), OAE

a. Two coats, 2.0-4.0 mils dry film thickness

4. Follow all other paint manufacturer recommendations for preparation and application.

3.4 CORROSION PROTECTION

A. Refer to Section 33 11 13 and Drawings for designation of corrosive soil zones in which buried valve assemblies require cathodic protection and/or corrosion monitoring and for specifications for design, materials, installation, energizing and testing of cathodic protection systems.

B. Ferrous components not in contact with soil do not require cathodic protection.

C. Stainless steel components do not require cathodic protection.

D. Do not use polyethylene encasement for valves or fittings that have cathodic protection.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.6 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on domestic site water transmission system in accordance with AWWA C605.

C. All valves, including butterfly valves, gate valves, and air valves shall be manually actuated through their full cycle to ensure proper operation prior to installation.

1. The Contractor shall provide the Engineer the opportunity to witness all valve actuations prior to valve installation.

D. Inspect coatings of all valves immediately prior to installation and repair all damaged coatings.

E. Properly align all pipes, valves and fittings prior to making connections. Do not install any pipes or fittings with internal longitudinal or shear stresses. Engineer reserves the right to disassemble any flange, joint, or union to check for internal stresses. Contractor shall correct any connection with internal stress at no additional cost to the Owner.

F. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project.

3.7 SPARE PARTS

A. Contractor shall supply the following spare parts to NTUA, at a location to be specified by NTUA within 75 miles of the project site:

1. Six (6) 2-inch vacuum relief valves with 1-inch air valves with inflow preventors.
2. One (1) 16-inch Class 150 butterfly valves
3. Four (4) 12-inch 350 psi gate valves
4. Eight (8) 16-inch x 12-inch DI MJ reducers
5. Two (2) 4-inch 350 psi gate valves
6. Five (5) locking cast iron valve box covers
7. Five (5) locking cast iron meter can covers

END OF SECTION

SECTION 33 12 18

CONTROL VALVE VAULT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Control Valve Vault

B. Related Sections:

1. Section 31 22 13 - Rough Grading.
2. Section 31 23 23 - Backfill.
3. Section 33 11 13 - Public Water Transmission Systems.
4. Section 33 12 16 - Water Utility Valves.
5. Section 33 13 00 - Disinfection of Water Utility Transmission Systems.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Control Valve Assemblies with Master Isolation Valve in Premanufactured Vault System:

1. Basis of Measurement: Each.
2. Basis of Payment: Includes all the necessary internal piping, tie-in piping, control valves, isolation valves, pressure relief valves, backfill, vault with ladder, cover and hatch, and other necessary appurtenances, as shown on the plans and specified herein.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M 306-10 - Standard Specification for Drainage, Sewer, Utility and Related Castings

B. ASTM International (ASTM)

1. ASTM A48 – Standard Specification for Gray Iron Castings
2. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. ASTM A536 – Standard Specification for Ductile Iron Castings
4. ASTM C478 – Precast Reinforced Concrete Manhole Sections
5. ASTM D638 – Standard Test Method for Tensile Properties of Plastics

C. American Water Works Association (AWWA):

1. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service
2. AWWA C530 Pilot Operated Control Valves.

3. AWWA C550 - Protecting Epoxy Interior Coating for Valves and Hydrants.
4. AWWA C605 - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.

D. American National Standards Institute

1. ANSI B16.1 Gray Iron Pipe Flanges and Flanged Fittings
2. ANSI C857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
3. C858 Standard Specification for Underground Precast Concrete Utility Structures.
4. C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
5. C913 Standard Specifications for Precast Concrete Water and Wastewater Structures.

E. NACE International (NACE)

1. SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings Prior to Installation.

F. NSF International/ American National Standard (ANSI):

1. NSF/ANSI Standard 61 - Drinking Water Components - Health Effects.

G. Society for Protective Coatings:

1. SSPC-SP1 – Solvent Cleaning
2. SSPC-SP2 – Hand Tool Cleaning

1.4 PREMANUFACTURED VAULT SYSTEM MANUFACTURER

A. Qualifications - The entire assembled vault shall be supplied as a complete package as manufactured in a dedicated facility specialized for this work. The supplier shall be experienced in control valves, have competent service technicians and a registered professional engineer on staff, stock valves and parts for control valves and be competent in all aspects of control valve applications, assembly, service, startup, training, and repair.

B. Manufacturer - The premanufactured vault system shall be as supplied by Pipestone Equipment

1.5 SUBMITTALS

A. Design Data: Submit manufacturer's latest published literature. Include illustrations, installation instructions, maintenance instructions and parts lists.

B. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data from material suppliers attesting that valves and accessories provided meet or exceed AWWA Standards and specification requirements.

C. Submit proofs on all signs, placards, and tags prior to fabrication.

D. Startup Procedures.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valve.

B. Provide Operation and Maintenance Data for each type of valve installed.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with applicable New Mexico Standards and the National Fire Protection Act (NFPA).

B. Valves: Mark valve body with manufacturer's name and pressure rating.

C. The control valve shall be tested prior to shipment. The standard test shall include a functional stroke test and pressure and leak test of valve body, seat and fitted pilots and accessories.

D. All control valve maintenance and repairs shall be possible without removing the Main Valve body from the line, when installed in accordance with manufacturer’s recommendations.

E. Start up and Training Services shall be provided by factory trained location representative. Representative shall have inventory of valves, pilots, and accessories, and have capability of providing maintenance, repairs, and modifications to add functionality to existing valves.

1.8 DELIVERY, STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA Standards and seal valve ends to prevent entry of foreign matter into product body.

B. Deliver and store valves in shipping containers with labeling in place.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior and exterior surfaces.

D. Coated valves and appurtenances shall be shipped on bunks and secured with nylon belt tie down straps or padded banding over braces and shall be stored on padded skids or other suitable means to prevent damage to coatings.

E. Coated valves shall be handled with wide belt slings, padded forks or other means to prevent damage to coatings. Chains, cables or other equipment likely to damage coatings or valves shall not be used.

1.9 COORDINATION

A. Contractor shall coordinate with the control valve station supplier regarding start-up services to be provided by the supplier and ensure required Contractor’s personnel and equipment are available.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.11 PUMPING PLANT 12 FOREBAY TANK CONTROL VALVE STATION DESIGN CRITERIA

Altitude Valve Setting Full PP12 Forebay Tank	31 FT
Operational Range	6 FT below Full Tank
Flow Control Maximum Flow Rate	1,571 GPM
Altitude Valve Max. Static Inlet Pressure	115 PSI
Altitude Valve Opening/Closing Speed	min 120 sec open / min 120 sec close
Pressure Relief Pilot Setting	125 PSI
Pressure Relief Valve Setting	135 PSI
Test Pressure Rating	Min. 235 PSI
Elevation	6068 ft. MSL

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall be American made, unless otherwise specified.

B. All non-stainless steel and iron valves and appurtenances shall be fusion bonded epoxy coated, interior and exterior, conforming to AWWA C550 and NSF 61.

C. All valves and coatings shall be NSF 61-certified.

D. All bolts, nuts, and washers (where required) shall be stainless steel 304, unless otherwise specified, and shall be provided by the valve or fitting manufacturer especially for use with their respective valves or fittings. If manufacturer cannot supply stainless steel bolts for the MJ or flange connection, Contractor may provide bolts from another source; however, Contractor is solely responsible to ensure fit and compatibility of said bolts.

2.2 MAIN CONTROL VALVE (UPSTREAM OF PUMPING PLANT 12 FOREBAY TANK)

A. Manufacturers:
1. Cla-Val, Combination Altitude, Flow Control, and Pressure Relief Valve, Cla-Val Model 210-21/50-01 BC2PRSVYKCKDKO-SST

2. Substitutions: Not allowed.

B. Working Pressure: 250 psi.

C. Main valve Size: 8”

D. Anti-Cavitation Trim

E. Full port

F. Valve Ends: Flanged connections shall be ANSI/ASME B16.42 Class 150.

G. Globe Style valve with single diaphragm-actuated configuration.

H. Body and bonnet shall be constructed of ductile iron conforming to ASTM A536 Grade 65-45-12.

I. The valve stem shall be a 316 stainless steel Dura-Kleen stem.

J. The main valve elastomers: diaphragm, resilient disc and seals, shall be of Buna-N or EPDM.

K. The main valve internal and external fasteners: bolts, nuts, studs, cap screws and washers shall be supplied as 304 Stainless Steel.

L. The main valve shall include Cla-Val NSF and AWWA approved fusion bonded epoxy coating.

M. Altitude Valve Pilots: The pilots shall be a normally open Cla-Val CDS6A Altitude Control, OAE.

1. The adjustable pilot spring ranges shall be 5 to 40 feet. The pilot shall be factory preset to 5 feet and to be fine-tuned in field by manufacturer’s representative during start-up.
2. Pilot body shall be constructed of low lead bronze. Pilot trim shall be 303 stainless steel.
3. Pilot system shall contain the “R” reservoir testing feature.

N. Rate of Flow Control Pilot System: The Differential Pressure Pilot shall be a normally open Cla-Val CDHS-18 Differential Pilot Control, OAE.

1. The adjustable pilot spring range shall be supplied as 30 inches to 480 inches water column.
2. The pilot body and all pilot system fittings shall be stainless steel.
3. Pilot set-point shall correspond to a rate of flow of 1,571 gpm.
4. The pilot trim, consisting of a seat ring, stem and inner valve shall be constructed of AISI 303 stainless steel.
5. The pilot elastomers: diaphragm, inner valve and seals, shall be of Buna-N or EPDM.

O. Rate of Flow Orifice Plate

1. Cla-Val Model X52E
2. Stainless steel orifice plate shall have a bore hole of 5.60”, rated for 1,571 GPM.
3. Sensing line connection integral to orifice housing assembly.

4. ANSI Class 150 flange pattern.

P. Pressure Relief Pilot: The pilot shall be a Cla-Val CRL-60 SST Pressure Relief Control set up on the opposite side of the body as an independent 50-01 pilot system to override altitude and flow control functions.

1. The adjustable pilot spring range shall be 100 to 300 psi and to be fine-tuned in field by manufacturer's representative during start-up.
2. Pilot body shall be constructed of stainless steel. Pilot trim shall be 303 stainless steel.
3. Pressure rating 400 psi

Q. Pilot System Appurtenances:

1. Pilot System inlet strainer shall be a Cla-Val X43 wye strainer.
2. Opening speed control shall be a Cla-Val Model CV flow control comprised of stainless steel components.
   a. The opening speed shall be 120 seconds or greater.
   b. The speed adjustment shall be locked or secured to prevent unauthorized changes.
3. Closing speed control shall be a Cla-Val Model CV flow control comprised of stainless steel components.
   a. The closing speed shall be 120 seconds or greater.
   b. The speed adjustment shall be locked or secured to prevent unauthorized changes.
4. All pilot system control tubing and control fittings shall be 304 stainless steel.
5. Isolation ball valve(s) shall be comprised of stainless steel components.
6. All pilot elastomers: diaphragm, inner valve and seals, shall be of Buna-N or EPDM.

R. Visual Position Indicator- The control valve shall be supplied with a Cla-Val Model X101 Valve Position Indicator, OAE. The valve position indicator shall provide a visual reference to the Main Valve open position. The housing shall be stainless steel.

S. Pressure Gauges- the main valve shall be supplied with pressure gauges: 0 – 200 psi on the upstream side and 0 – 60 psi on the downstream sides of the valves, each with isolation and bleed valves for maintenance.

2.3 BUTTERFLY VALVES

A. Manufacturers:
1. Henry Pratt Co.
   a. Groundhog
2. Val-Matic Valve and Manufacturing Corporation
   a. Series 2400
3. Substitutions: Approved Equal

B. 250 psi Butterfly Valves:

1. Conforming to AWWA C504, Pressure class AWWA 250B, MSS SP 67 and NSF 61.
2. Rated to 250 psi full differential working pressure.
3. Shell test pressure 500 psi.
4. Leak test at 250 psi.
5. Body: Ductile iron, drilled in accordance with ANSI B16.1 Class 125, stainless steel shaft. Body wall thickness shall be in accordance with AWWA C504.

C. Valve Ends:

1. Flanged ends shall be drilled in accordance with ANSI Class 125/150 bolt pattern.
2. Pressure rating not less than that of valve body.

D. Disc: Epoxy-coated cast iron, with stainless steel 316 edge.

E. Seat: Resilient Buna N.

F. Shafts: Shall be sized, designed and constructed in conformance with AWWA C504 for pressure class AWWA 250B. Shafts shall be SS ASTM A-276 Type 304.

G. Slow Close Actuator for 8" Master Isolation Valve at PP12 Tank Site

1. Handwheel operation with 2" operating nut to allow for operation from outside of vault.
2. Quarter-turn manual gearbox with 360-degree bronze worm wheel.
   a. AUMA GS100.3
   b. Reduction radio: 160:1
   c. Mechanical advantage: 55.5
   d. Swing angle: 92 degrees, adjusted at factory
   e. Turns for 90°: 40
3. Corrosion protection KS with powder coating

2.4 BALL VALVES

A. Stainless steel ball valves for air and vacuum breaker valve assemblies

1. Size: ¼-inch, ½-inch, 1-inch, 2-inch, or 3-inch, as shown on Drawings
2. May be imported or domestic
3. Manufacturers:
   a. Milwaukee Valve
   b. Apollo
   c. Approved equal
4. Working Pressure: Not less than 250 psi
5. Inlet/Outlet: FNPT, or as shown on Drawings

6. All stainless steel construction, including body, tailpiece, ball, ball retainer, stem, handle, handle nut, packing nut, and lock washer
7. Valve shall be actuated manually using lever-type handle, one-quarter turn to open and close. Handle length and range of motion shall allow handle to be located in the most accessible location without interference with any other object.

2.5 STRAINER

A. Manufacturers:
   1. Cla-Val, H Style Strainer, Cla-Val Model X43H
   2. Substitutions: Not allowed.

B. Valve Ends: Flanged connections shall be ANSI/ASME B16.42 Class 150.

C. Working Pressure: 250 psi.

D. Fusion bonded epoxy coated ductile iron body.

E. Integral drain/blow off connection with stainless steel plug.

2.6 DISMANTLING JOINTS

A. Manufacturer:
   1. ROMAC, Model DJ400
   2. Substitutions: Approved Equal

B. Flanges: AWWA C207 Class E steel ring flange, compatible with ANSI Class 125 & 150 bolt circles.

C. NSF 61 Certified fusion bonded epoxy coating

D. NBR gasket

E. Integral Tie Rods

F. 316 stainless steel fasteners

G. Working pressure: 275 psi

2.7 AIR VALVES

A. ½ -inch air release valve (control valve vault):
   1. Manufacturer:
      a. Val-Matic Valve and Manufacturing Corporation, 22.7SVH
      b. Substitutions: Approved Equal
   2. Working pressure: 300 psi
   3. Outlet: ½ ” NPT
   4. Cast iron or ductile iron body, cover and baffle; stainless steel trim, float, and fasteners.

5. ARV shall include hood.
6. Seat: Resilient Buna N.
7. Internal and external coatings shall be fusion bonded epoxy conforming to NSF-61 requirements.

2.8 PRESSURE RELIEF VALVE

A. 1” Pressure Relief Valve
   1. Manufacturers:
      a. Cla-Val, Pressure Relief Valve, Cla-Val Model No. 1" 55L-60 SST
      b. Substitutions: Not allowed.
   2. Working pressure: 400 psi
   3. Spring Range: 100 to 300 psi
   4. Outlet: 1 ” NPT
   5. Globe type
   6. 316 Stainless Steel
   7. Pressure relief valve to be set 10 psi higher than pressure relief pilot on control valve.

2.9 PIPE SUPPORTS

A. Manufacturer:
   1. Standon, S8900 Series
   2. Substitutions: Approved Equal
B. 304 stainless steel
C. Size per drawings
D. 8”x8”x3/8” thick base plate bolted to chamber floor

2.10 VALVE VAULTS

A. Concrete manhole sections conforming to ASTM C478.
   1. Bell and spigot joints.
   2. Symmetrical reinforcement only.
   3. Soil-tight gasket conforming to ASTM C-990.
B. Concrete shall conform to Section 03 30 00 – Cast-in-Place Concrete.
C. Concrete shall be 4000 psi.
D. Manufactured or cut to lengths shown on Drawings.
E. “Mouse hole” or circular cut-outs to accommodate main line pipe inside vaults shall be pre-cast and shall include epoxy coated wall sleeves.
F. Pre-fabricated reinforced flat, slab-type lids with hinged, lockable hatches as shown on Drawings.

G. Square access covers:

1. Manufacturers:
    a. Halliday Products, Series W1S or W2S as shown on drawings
    b. Substitutions: OAE
2. Dimensions as shown on Drawings.
3. Load Rating: 300 lbs
4. Gasketed lid with channel system to divert water
5. Assisted opening with slam prevention system
6. Bituminous coating
7. Stainless Steel Hardware
8. Insulated Lid
9. Recessed Lockable Hasp and lifting handle

H. Foam insulation.

1. 2” minimum thickness
2. Spray Foam Insulation.
    a. 2-lb closed cell, two-component, rigid polyurethane.
    b. R Value per inch of 6.6 or greater (K factor 0.15 or less).
    c. Suitable for application to low temperature substrates (15°F).
    d. Waterproof mixture in sealant
3. Sheet insulation may be considered by the Engineer as a substitute if demonstrated to meet or exceed the properties of spray foam insulation, including resistance to moisture build up or condensation behind the insulation. The burden to demonstrate the properties of any substitute shall be borne by the Contractor.

I. Safety Ladder

1. 6005T5 aluminum construction.
2. 5086 H116 Aluminum bracket.
3. Stainless steel bolts.
4. Shall be supplied with a locking and retractable safety post.
5. 10 ft tall, cut to suit application

J. Valve Box

1. Cast iron
2. Cast iron lid marked “Water”.
3. Heavy duty, traffic rated.
4. Locking lids with standard pentagon nut.

2.11 VALVE IDENTIFICATION PLACARD FOR ALTITUDE VALVE

A. Rectangular stainless steel 430 plate with 4 x ¼" pre-drilled holes

B. Dimensions: 8"w x 6"h x 0.029"t or as shown on plans

C. Laser-etched lettering using Cermak LMM6000 laser marking promoter with 150 watt CO2 laser.

D. Arial font with size as large as permitted by placard dimensions and pre-drilled holes, centered horizontally and vertically on placard; minimum 3/8" letter height.

E. Valve identification placards shall be affixed to concrete with four 3/16" diameter x 1-¼" length concrete screws

F. Submit a proof to Engineer for approval before producing placards.

2.12 ACCESSORIES

A. Concrete for thrust restraints, blocks and collars: Concrete type specified in Section 03 30 00.

2.13 DUCTILE IRON PIPES AND FITTINGS

A. Refer to Section 33 11 13.

2.14 STAINLESS STEEL PIPES AND FITTINGS

A. Refer to Section 33 11 13.

2.15 SOURCE QUALITY CONTROL

A. Coatings:

1. Cure testing for fusion bonded or liquid epoxy coatings: ASTM D4752 and ASTM D3363, Every 1000 sq. ft. of epoxy coating.

2. Holiday testing for epoxy coatings:

a. All fusion-bonded epoxy coatings on all valves shall be holiday tested prior to installation, at Contractor's expense.

b. Perform testing in accordance with NACE Standard SP0274, using electrical holiday tester. Use test voltage below:

Total Coating Thickness (Mils)	Test Voltage (Volts)
20 or less	6000
30	7500
50	9000
70	11500
80 or more	12000

c. All holidays shall be repaired and re-tested, at no additional cost to the Owner.

3. Touch up and repair of Fusion Bonded Epoxy Coatings

a. Applies to all FBE coated valves for field repair of minor holidays, scratches, breaks or other damage to FBE coating.

b. Does not include repair or touch up of systemic or large area holidays in FBE coating. Repair of systematic holidays or damaged areas larger than three (3) sq. in. will require the damaged coating be ground off and the valve be newly shop-coated.

c. Materials and application:
   1) NSF/ ANSI 61 certified, two-part, 100% solids, liquid epoxy coating meeting the requirements of AWWA C210.
      a) Manufacturer: 3M Scotchkote Epoxy Coating 323, OAE.
      b) If temperature is below 55 degrees Fahrenheit, the metal substrate shall be pre-heated in accordance with coating manufacturer's recommendations prior to applying the coating.

d. Prepare surface and apply per coating manufacturer's instructions for use as a field repair material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of work.

B. Verify invert elevations prior to excavation and installation of valves.

3.2 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission or without making arrangements to provide temporary utility services.
   1. Notify Engineer not less than 48 hours in advance of proposed utility interruption.
   2. Do not proceed without written permission from the Engineer.

D. Perform trench excavation, backfilling and compaction in accordance with Sections 31 23 17 and 31 23 23.

3.3 INSTALLATION

A. Valve Vaults
   1. Thoroughly clean vault section ends with wire brush prior to joining sections.
   2. Place vault sections with bell down.

3. Seal all vault sections with sealant approved by Engineer.

4. Grout lids as directed by Engineer.

5. Field apply foam insulation in accordance with manufacturer's instructions and recommendations. Personnel applying spray foam insulation shall be sufficiently trained by the manufacturer, the Center for the Polyurethane Industry, the Spray Polyurethane Foam Alliance, or similarly competent certifying body.

B. Apply heavy duty anti-seize to lubricate all stainless steel bolts. Anti-seize compound shall be recommended by manufacturer for use with stainless steel bolts.

C. Assemble steel flanged joints in accordance with AWWA M11 and AWWA C207.

D. Tracer wire:

1. Coil min. 24" tracer wire against wall on each side of vault.

3.4 PRE-START-UP PREPARATION

A. Close upstream gate valve to vault prior to flooding adjacent main pipeline(s).

B. Flush the main line upstream of the vault thoroughly using the flush valve upstream of the vault prior to opening the altitude valves. This precaution is necessary to prevent construction debris from entering the control valve.

C. Once the main line has been thoroughly flushed and cleared, open the gate valve to flood the control valves.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00.

3.6 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on domestic site water transmission system in accordance with AWWA C605.

C. All valves, including control valves, ball valves, and air valves shall be manually actuated through their full cycle to ensure proper operation prior to installation.

1. The Contractor shall provide the Engineer the opportunity to witness all valve actuations prior to valve installation.

D. Inspect coatings of all valves immediately prior to installation and repair all damaged coatings.

E. Properly align all pipes, valves and fittings prior to making connections. Do not install any pipes or fittings with internal longitudinal or shear stresses. Engineer reserves the right to disassemble any flange, joint, or union to check for internal stresses. Contractor shall correct any connection with internal stress at no additional cost to the Owner.

F. All tracer wire must be field checked for continuity after all excavation is completed, but prior to Final Completion of the project.

3.7 START-UP SERVICES

A. Provide at least one (1) full 8-hour day of service from manufacturer's representative to approve the control valve station installation and advise the Contractor during startup, testing, and final adjustment of control valve station. In addition to this day, one additional one (1) full 8-hour day shall be provided in a separate trip to instruct the Owner's personnel in the operation and maintenance of the control valve station.

B. Start-up service shall include but not be limited to final adjustments of pressure, flow rate, and speed settings and testing of valves.

C. The Contractor shall provide necessary personnel during start-up and training to facilitate this work and to address any problems or defects which may arise during this work.

D. The control valve station manufacturer's start-up service technician shall prepare a service report following start-up and distributed as follows:

1. Manufacturer's File
2. Engineer's File
3. Contractor's File
4. Owner's File

3.8 WARRANTY

A. The control valves shall be covered by a minimum three (3) year warranty against defects in materials and workmanship. The 316 stainless steel seat ring shall be covered by lifetime warranty.

B. Unless otherwise specified above, the interior equipment, valves, piping, and apparatus shall be warranted for a period of one (1) year, excepting only those items normally consumed in service, such as oil, grease, gaskets, or O-rings.

C. All warrantee periods cannot start any earlier than issuance of Affidavit of Punch List Completion (APLC) by NTUA.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER UTILITY TRANSMISSION SYSTEMS

PART 1 GENERAL

Note: BBN9 Reach 10.1, Reach 10.2 and Reach 10.3 shall be thoroughly flushed at the time of construction as described in this technical specification; however, disinfection and bacteriological testing will not occur at time of construction and are not included in the project. The disinfection and testing described in this technical specification are to be used during the commissioning of Reach 10.1, Reach 10.2 and Reach 10.3, after the San Juan Lateral Water Treatment Plant is operational.

1.1 SUMMARY

A. Section includes disinfection of potable water transmission system; and testing and reporting results.

B. Related Sections:

1. Section 33 11 13 - Public Water Transmission Systems: Product and Execution requirements for installation, testing, of site domestic water transmission system piping.

2. Section 33 12 16 - Water Utility Valves.

1.2 MEASUREMENT AND BASIS OF PAYMENT

A. Basis of Measurement: By the linear foot for pipeline and wash crossings. Incidental to work for all other facilities (incl. chlorination building, pump station, surge tank, site piping and other facilities).

B. Basis of Payment: Payment for pipeline disinfection will be made based on linear footage, upon successfully passing bacteriological testing. Disinfection of other facilities (including pump station, tanks, surge tank, and site piping) shall be incidental to their respective bid items.

1. This includes all costs incidental to disinfection and testing, including chlorination, flushing, water for flushing, de-chlorination, sampling, sample transport, laboratory testing fees, and any other costs incidental to flushing, disinfection, and bacteriological testing activities.

2. Bacteriological testing costs shall not be allowed under the Testing Allowance.

1.3 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites.

2. AWWA B301 - Liquid Chlorine.

3. AWWA B303 - Sodium Chlorite.

4. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

5. AWWA C651 - Disinfecting Water Mains.

B. New Mexico Administrative Code (NMAC) - Title 20, Chapter 7, Part 10:

1. Section 201: Application for Public Water System Project Approval.
2. Section 400: General Operating Requirements.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.

C. Testing Plan: Contractor must submit proposed testing procedures specific to the project including laboratory name and contact information, testing/sampling locations, locations where flushing water will be obtained for the pipeline flushing, disinfection, and final flushing, method for disposal of de-chlorinated water and equipment to be employed for disinfection for approval by Engineer.

D. Test Reports: Indicate results comparative to specified requirements.

E. Certificate: Certify cleanliness of water transmission system meets or exceeds specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Notarized affidavit confirming that disinfection has been completed according to the referenced AWWA standards.

D. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.

7. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.

E. Water Quality Certificate: Certify water conforms to quality standards of authority having jurisdiction, suitable for human consumption.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.

1.7 QUALIFICATIONS

A. Testing Firm: Company specializing in testing potable water systems, certified by State of New Mexico.

B. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, and AWWA B303, Sodium Chlorite.

B. All chemicals shall be NSF/ANSI 60 certified disinfection chemicals.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

A. Coordinate with Bureau of Reclamation, NTUA, and the Engineer prior to filling, flushing or disinfecting the pipeline. Refer to Section 01 00 00 – Basic Requirements for coordination requirements.

B. Prior to disinfection, thoroughly flush the system with potable, disinfected water. A minimum flow velocity of 3 feet per second (fps) is required, or as otherwise approved by Engineer.

C. Provide and attach required equipment to perform the Work of this section.

D. Introduce treatment into piping system and perform disinfection in accordance with AWWA C651. A minimum chlorine concentration of 50 ppm shall be measurable throughout all parts of the system.

1. Measure chlorine concentration at all sampling ports provided on the Drawings, including air valve vaults plumbing.

E. Maintain disinfectant in system for 24 hours, or 48 hours if the temperature is less than 41 degrees Fahrenheit.

F. Flush, circulate, and clean using domestic water.

1. Contractor shall coordinate with Bureau of Reclamation, NTUA and Engineer prior to using domestic water, to avoid interruption of service to existing customers. Contract shall not exceed maximum allowable instantaneous flow (gpm) or daily flow (gpd), as specified in the field by NTUA and Engineer.
2. Neutralize residual chlorine to levels normally associated with potable water prior to discharging water to the environment.

G. Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.

B. Disinfection Flushing, and Sampling:

1. The flushing water in the pipeline will be displaced with chlorinated water.
2. After disinfectant has been in system for 24 hours, chlorine will be neutralized.
3. The waterline will be flushed using potable water.
    a. The neutralized water will be discharged from flush valves located along the waterline.
4. Disinfect and test pipeline installation in accordance with AWWA C651.
5. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that of the water used for flushing or 0.4 ppm, whichever is greater.
6. After final flushing and before pipeline is connected to existing system, or placed in service, employ an approved independent testing laboratory, approved by the Engineer, to sample, test and certify water quality suitable for human consumption, in accordance with AWWA C651.
    a. At least one set of bacteriological samples shall be collected from every 1,200 LF of new waterline, plus one set at each end of the line, unless otherwise approved by NTUA and the Engineer.
    b. Contractor shall install testing saddles, if needed to comply with spacing requirements for bacteriological testing under AWWA C-651 and NTUA’s requirements. Such testing saddles are not shown on the plans, but shall be considered incidental to the project.
    c. The number and locations of specific sampling sites shall be submitted by the Contractor and must be approved by the Engineer prior to sampling.
    d. Bacteriological tests are typically only valid for 30 days. Two consecutive passing test results at every sample location must therefore be obtained within 30 days of Final Completion and Transfer of completed project to NTUA. Note that NTUA will not accept project transfer until all punch list items have been completed and the project has been inspected by NTUA personnel. NTUA typically requires 21 days notice prior to final inspection

and Transfer. Contractor is solely responsible for coordination with NTUA. If punch list inspection, Final Completion, and NTUA Transfer cannot be completed within 30 days of all bacteriological tests, regardless of the reason for delay, Contractor shall be responsible for re-testing at Contractor's expense.

7. Contractor shall not connect to existing system until all testing and disinfection is complete and shall obtain written permission from the Engineer to proceed with connection to the existing system.

C. Re-Disinfection:

1. In the event the performed water quality testing fails, the Contractor will disinfect the affected portions of the system again, and the approved testing laboratory shall sample, test and certify water quality as described in these specifications. Re-disinfection shall be performed at no additional cost to the Owner.

END OF SECTION

SECTION 33 13 13

WATER STORAGE TANK DISINFECTION

PART 1 GENERAL

Note: BBN9 Reaches 10.1, 10.2 and 10.3 shall be thoroughly flushed at the time of construction as described in this technical specification; however, disinfection and bacteriological testing will not occur at time of construction and are not included in the project. The disinfection and testing described in this technical specification are to be used during the commissioning of Reaches 10.1, 10.2 and 10.3, after the San Juan Lateral Water Treatment Plant is operational.

1.1 SUMMARY

A. Section Includes:

1. Water tank disinfection.
2. Bacteriological testing.

B. Related Sections:

1. Section 09 97 14 - Water Storage Tank Painting.
2. Section 33 16 19 - Welded Steel Water Storage Tank.
3. Section 33 16 21 – Glass Coated Bolted Steel Water Tank

1.2 REFERENCES

A. American Water Works Association:

1. AWWA C652 - Disinfection of Water Storage Facilities.

1.3 MEASUREMENT AND BASIS OF PAYMENT

A. Basis of Measurement: Lump sum for each tank.

B. Basis of Payment: Via separate bid item on the Bid Form. Bid item price shall include all work performed by Contractor and testing laboratory related to disinfection, testing and analysis.

C. The cost of laboratory testing for bacteriological testing shall not be allowed under the Testing Allowance.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal procedures.

B. Disinfection Procedure: Submit procedure description including type of disinfectant to and calculations indicating quantities of disinfectants required to produce specified chlorine concentration in accordance with Section 3 and 4 of AWWA C652.

C. Test Reports: Indicate results of bacteriological and residual chlorine laboratory test reports.

D. Manufacturer's Certificate:

1. Certify products meet or exceed specified requirements.
2. Certify disinfectants meet or exceed AWWA Standards requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C652.

B. Perform Work in accordance with State of New Mexico Environment Department standards.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store disinfectants in cool, dry place away from combustibles such as wood, rags, oils and grease.

B. Handle disinfectants with caution; protect skin and eyes from contact; avoid breathing vapors; wear gloves, aprons, goggles, and vapor masks.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Furnish personnel working inside tank during disinfection with equipment to comply with Federal and State regulations for work conducted in hazardous atmosphere.

B. Neutralize disinfectant solution before disposal.

C. Legally dispose of disinfection solution off Project site.

D. Repair damage caused by disinfectant solution and disinfection procedures.

PART 2 PRODUCTS

2.1 DISINFECTANTS

A. Chlorine Forms: In accordance with AWWA C652, Section 4.2.

B. All chemicals shall be NSF/ANSI 60 certified disinfection chemicals.

PART 3 EXECUTION

3.1 EXAMINATION

A. Conduct inspection of tank interior before beginning disinfection.

1. Verify tank is clean and free of polluting materials.
2. Verify tank pipe and vent connections are properly made and clear of obstructions.
3. Verify paint is thoroughly cured in accordance with paint manufacturer's instructions.

3.2 PREPARATION

A. Protect aquatic life and vegetation from damage from disinfectant solution purged from tank.

3.3 APPLICATION

A. Welded Steel Tanks

1. Use Chlorination Method 1, 2, or 3 for disinfecting tank as specified in Section 4.3 of AWWA C652.

3.4 FIELD QUALITY CONTROL

A. Section 01 00 00 - Testing, adjusting and balancing requirements.

B. Collect samples of water from filled tank for bacteriological analysis in accordance with Section 5.1 of AWWA C652; take inlet and outlet water samples.

C. Test water samples for bacterial contamination, residual chlorine, in accordance with State Health Standards for potable water.

D. When water samples fail to meet State Health Standards for potable water perform the following corrective measures until water quality conforms to State Health Standards:

1. Inlet and Outlet Water Sample Failure: Eliminate source of contamination in water supply, repeat disinfection, and retest water quality.

2. Outlet Water Sample Failure: Repeat disinfection, and retest water quality.

END OF SECTION

SECTION 33 16 19

WELDED STEEL WATER STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section of the specifications consists of furnishing all plant, labor, equipment and materials in performing all operations in connection with the manufacture, delivery and erection of factory epoxy primed and field epoxy coated welded steel water storage tanks to the height and capacity specified, complete with foundation design and construction, and appurtenances, subject to the terms and conditions of the contract, and in strict accordance with this section of the specifications and the applicable drawings.

Section Includes:

1. Welded steel water storage tanks.
2. Tank foundations.

B. Related Sections:

1. Section 01 00 00 - Basic Requirements
2. Section 03 30 00 - Basic Concrete Materials and Methods.
3. Section 09 97 14 - Water Storage Tank Painting.
4. Section 26 42 10 – Impressed Current Cathodic Protection.
5. Section 31 23 17 - Trenching.
6. Section 31 23 23 - Backfill.
7. Section 33 11 00 – Water Utility Distribution Piping.
8. Section 33 13 13 - Water Storage Tank Disinfection.

1.2 REFERENCES

A. Subsurface data:
1. See Section 01 00 00 Basic Requirements for any geotechnical reports and subsurface data and/or reports available.

B. American Concrete Institute:

1. ACI 318 - Building Code Requirements for Structural Concrete.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

D. American Society of Mechanical Engineers:

1. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

E. American Water Works Association:

1. AWWA D100 (latest revision) - Welded Steel Tanks for Water Storage. All references in this Section to AWWA D100 shall be understood to mean AWWA D100 (latest revision).

1.3 DEFINITIONS

A. PURCHASER used in AWWA D100 means Owner.

1.4 SYSTEM DESCRIPTION

A. Design, fabricate, and erect welded steel water storage tanks and accessories. Design and construct steel retaining ring or reinforced concrete ring wall foundation, and cathodic protection system, complete in place.

1.5 DESIGN REQUIREMENTS

A. Design in conformance with requirements listed in AWWA D100 (latest revision) as noted, supplemented, or modified below:

1. Capacity:

a. Nominal capacity shall be as indicated on Drawings.
b. All tank capacities shown on drawings are nominal sizes, actual tank volumes shall be within 2% of the nominal value.

2. Approximate tank dimensions are as indicated on Drawings.
a. Actual heights of tank overflow and inlet riser, if present, shall be verified and adjusted by Contractor in field to meet the requirements and tolerances called for on the Drawings.
b. The carbon steel tank shall have the dimensions shown in the Drawings. Vendor to quote on the nearest standard size welded tanks of manufacture meeting the requirements and tolerances described herein and on the Drawings.

3. The tank wall plate thickness shall be a minimum of ¼”.

4. Bottom capacity level (BCL) and top capacity level (TCL) above top of column foundations.

5. Roof: Welded conical roof.
a. Roof support: as determined by tank manufacturer’s licensed engineer.

6. Location of Site: As indicated on Drawings.

7. Access Roads: As indicated on Drawings.

8. Snow Loading: As per AWWA D100, (latest revision).

9. Lateral Design:
a. Wind and Seismic Loading: As per AWWA D100, (latest revision). The load producing the higher stresses comparing wind and seismic will control the dynamic portion of design.
b. The Contractor shall include sloshing wave calculations as part of their design submittals, and size the height of the tank accordingly to provide the calculated freeboard.

10. Tank low level is defined as level when emptied through specified discharge fittings unless otherwise indicated on Drawings.

11. Cathodic protection shall be impressed current type. Refer to the following Section:
    a. Section 26 42 10 – Impressed Current Cathodic Protection.

B. Design and construct foundation based upon data and recommendations provided in Subsurface (Geotechnical) Investigation Report.

1.6 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures.

B. All required parts of the tank submittal indicated in this section shall be submitted in a single complete bound package. Each separate part of the package shall be sectionalized and tabbed.

C. Construction shall be governed by the Drawings showing general dimensions and construction details. After approval by the Engineer of detailed erection drawings prepared by the Contractor, there shall be no deviation from these drawings and specifications except upon written order or approval from the Engineer.

D. Shop Drawings: Signed and sealed by professional engineer licensed in the State in which the tank is to be constructed. Indicate the following:

1. Tank Shop Drawings:
    a. Complete plan, elevation, and sectional drawings showing critical dimensions.
    b. Structural plate and support member sizes and thickness.
    c. Weld types and sizes.
    d. Water supply and overflow piping details including fittings, expansion joints, and pipe support methods.
    e. Exterior ladder safety device details.
    f. Handrail details.
    g. Access hatch details.
    h. Level indicator details.
    i. Vent details.
    j. Other appurtenances as indicated on plans or as provided by manufacturer.
    k. Cathodic protection details.

2. Tank Foundation Shop Drawings:
    a. Submit specification for foundation describing all material to be used, configuration, compaction requirements, etc. prepared by professional engineer licensed in the State in which the tank is to be constructed.
    b. If proposed foundation is constructed of concrete, indicate the following:

1) Ingredients, reinforcement, air content, slump, placement and consolidation, curing and finishing.

2) Submit concrete design mix including ingredient proportions, minimum cement content, and water/cement ratio.

3) Submit drawings of reinforcing bars including bar lists.

E. Product Data:

1. Submit data for expansion joint fittings and other pipe specialty fittings.

2. Submit data for ladders and ladder safety devices.

3. Submit data for cathodic protection components.

F. Design Data: Submit structural calculations for tank, tank foundation, and cathodic protection, signed and sealed by professional engineer licensed in the State in which the tank is to be constructed.

G. Test Reports: Submit radiographic films, identified to shell plate diagrams, at completion of the Work.

H. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

I. Certificates:

1. Submit names and qualifications of welders, welding operators and tackers before performing welding.

2. All certifications must be valid at the time the work is to be performed.

J. Manufacturer's Field Reports: Certify foundation, anchor bolts, and tank have been properly installed and leveled.

K. The intent of these specifications is to provide the Owner with a water storage tank of the dimensions stated, requiring minimum maintenance. Alternative submittals will be accepted, provided the installation offered can be shown to be “equal” to the specified standard of quality, beyond reasonable doubt.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual location layout and final configuration of elevated tank and accessories.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA D100.

1.9 QUALIFICATIONS

A. Fabricator: Company specializing in performing work of this section with minimum five years experience.

B. Installer: Company specializing in performing work of this section with minimum five years experience, approved by Engineer.

C. Welders, Welding Operators, and Tackers: ASME Section IX qualified within previous 12 months. American Welding Society (AWS) certification must be valid as defined by AWS,

with certification maintenance forms submitted every six months as per the AWS Code of Acceptance.

D. AWWA D100, (latest revision)- Welders Credentials: Refer to AWWA D100, (latest revision).

E. Design ground supported water tank and foundations under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State in which the tank is to be constructed.

1.10 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Pre-Construction Conference.

B. Convene minimum one week prior to commencing work of this section.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

B. Contractor responsible to field survey tank overflow weirs.

1.12 COORDINATION

A. Section 01 00 00 - Basic Requirements: Coordination requirements.

B. Section 02 21 13 – Surveying: Coordination requirements.

C. Coordinate work with connecting to water transmission system.

1.13 MAINTENANCE MATERIALS

A. Section 01 00 00 - Basic Requirements: Operation and maintenance data requirements.

B. Furnish a safety harness for ladder safety rail system.

PART 2 PRODUCTS

2.1 WATER STORAGE TANK

A. Furnish materials complying with this specification and standards specified in AWWA D100, (latest revision).

2.2 TANK CONSTRUCTION

A. In conformance with requirements listed in AWWA D100, (latest revision) as noted, supplemented, or modified below:

1. The tank wall plate thickness shall be a minimum of ¼”.

2. Carbon Steel:

a. Sheet. Carbon steel sheets shall conform to, or be at least equal to, hot-rolled quality per ASTM A570 Grade 40 with a minimum yield strength of 40,000 psi.

b. Plate. Carbon steel plates shall conform to, or at least be equal to, the requirements of ASTM A36 with a minimum yield strength of 36,000 psi.

c. Structural Shapes. Carbon steel structural shapes shall conform to ASTM A36.

3. Aluminum: 5052-H32, 6061-T6 typical grades (limited size).

4. Stainless Steel: 304, 316, 316L, 317 typical grades.

5. All carbon steel plates, supports, members and miscellaneous parts, except bolts, shall be coated in accordance with Section 09 97 14. Bolts shall be stainless steel.

6. Pipe and Fittings for Fluid Conductors: AWWA D100, (latest revision)- Steel Pipe for Fluid Conductors: Modify to indicate only welded joints for conductors are acceptable.

7. Balcony: AWWA D100, (latest revision).

8. Manways, Ladders and Other Accessories: AWWA D100, (latest revision):

   a. Section 5.1 - Steel Riser: Provide manways as shown on Drawings. Manways shall have a minimum I.D. of 30" and shall be located as indicated on Drawings.

   b. Section 5.4 - Ladders: Provide tower, outside and roof ladders.

9. Pipe and Pipe Connections:

   a. AWWA D100, (latest revision):

      1) Provide inlet pipe with diameter as indicated on Drawings. Extend pipe through bottom of tank.

      2) Provide removable steel silt stop with same coating as tank interior and mechanical joint gland.

   b. Provide other accessories as indicated on Drawings.

10. Tank Floor: Floor to slope upwards 1% towards center to prevent "oil canning".

11. Removable Silt Stop: AWWA D100, (latest revision) Provide removable silt stop.

12. Overflow: AWWA D100, (latest revision)- Overflow. Provide welded joint steel overflow pipe as indicated on Drawings suitably supported and extending to grade level; diameter of overflow as indicated on Drawings. Provide overflow weir box designed to handle the maximum anticipated flowrate (at high water level) as indicated on Drawings.

13. Roof Ladder: As indicated on Drawings and designed to meet OSHA Standards, and AWWA D100, (latest revision). Ladder must extend to 2' off the ground.

14. Fall Arrest Systems, Rest Platforms, Roof-Ladder Handrails or Other Safety Devices: AWWA D100, (latest revision) and OHSA Standards (latest revision).

   a. Safety Devices: Provide have a personal fall arrest system complying with OSHA Standards, along entire ladder length.

   b. Provide anchor points for operator to connect lanyards, "pelicans" or similar personal safety devices, complying with OSHA standards, at three points along roof of tank: near top of ladder, between center of tank and roof hatch, and near center of tank.

c. Ladder shall be secured with a locking ladder guard for at least the first 10-feet of the ladder.

15. Special Vent Required for Screening of Tank Vent: AWWA D100, (latest revision) - Vent. Mushroom vent above maximum water level of sufficient size to accommodate maximum inlet and outlet water flow. The overflow pipe shall not be considered a tank vent. Provide aluminum, fiberglass, or bronze insect screen, 24-mesh. Vent shall be frost proof. Maximum water flow as follows:

    a. Vent capacity: Maximum anticipated flowrate (at high water level) as indicated on Drawings.

16. Hatch: Provide tank roof hatch with curbed, upward opening 30" square manway, unless indicated otherwise on Drawings. The curb shall extend at least 4 inches above the tank. The hatch cover lip shall be hinged and provisions made for locking. The hatch cover lip should extend for a distance of 2 inches down on the outside of the curb.

17. Water Level Indicator: A water level indicator shall be furnished including target, cable, floats, channel, guides, etc., as required for complete assembly.

18. Target cables shall be provided with guides to prevent cables from tangling with target.

19. Additional Accessories: AWWA D100, (latest revision) - Additional Accessories.

20. Butt-Joint Welds: AWWA D100, (latest revision) - Welding. Modify to indicate lap welds tack welded on one side are not permitted. Seal welding is required.

21. Written Report Certifying Work: Prepare and submit as specified in AWWA D100, (latest revision).

22. Submit radiographic film and test segments.

23. Complete-Joint-Penetration Welded Shell Butt-Joints: Inspection as specified in AWWA D100, (latest revision).

24. Surface Preparation: Refer to Section 09 97 14.

25. Seal Welding: AWWA D100, (latest revision). Provide seal welds for lap joints in wet areas including interior roof surfaces.

26. Soil Investigation and Foundation: AWWA D100, (latest revision). Soil data available for review.

27. Pile-Supported Foundation: AWWA D100, (latest revision). When required, in accordance with manufacturer's design.

28. Effect of Buoyancy on Foundation Design: AWWA D100, (latest revision).

29. Concrete: ACI 318.

30. Vertical Distance from Finished Ground Level to Crown of Inlet and Outlet Pipes at Tank Foundation: AWWA D100, (latest revision). As indicated on Drawings.

31. Specification Sheet for Seismic Data: AWWA D100, (latest revision).

32. Vertical Acceleration: AWWA D100, (latest revision).

33. AWWA D100, (latest revision)

a. Reinforcing Steel: Modify to use only Grade 60.

2.3 REINFORCEMENT

A. Reinforcing Steel Bars: ASTM A615/A615M, Grade 60, ACI 318, in accordance with Section 03 20 00, as applicable.

2.4 CONCRETE

A. The tank foundation shall be designed by the tank manufacturer based upon the recommendations of a geotechnical engineer to safely sustain the structure and its live loads. The tank foundation design shall be stamped by the tank manufacturer's Professional Engineer licensed in the State in which the tank is to be constructed.

B. Concrete: ACI 318, minimum compressive strength 4,000 psi at 28 days, in accordance with Section 03 30 00, as applicable.

2.5 INLET AND OUTLET PIPE

A. Inlet, outlet, and overflow connections shall conform to sizes and locations specified on Drawings.

B. Inlet and Outlet Pipe: ASTM A53/A53M, Grade B, Schedule 40, steel pipe, welded joints.

C. Coatings: Refer to Section 09 97 14 – Water Storage Tank Painting.

2.6 OVERFLOW PIPE

A. Overflow Pipe: ASTM A53/A53M, Grade B, Schedule 40, steel pipe, welded joints.

B. Coatings: Refer to Section 09 97 14 – Water Storage Tank Painting.

2.7 OTHER MATERIALS

A. Furnish other materials in accordance with AWWA D100, (latest revision) to complete installation.

2.8 FABRICATION

A. AWWA D100, (latest revision)- Shop Fabrication: No changes or modification to this Section.

2.9 DELIVERY

A. All tanks, structures and miscellaneous parts shall be packaged for shipment in such a manner as to prevent abrasion or scratching.

B. Delivery will be accomplished on specially designed, self-loading trailers featuring air-ride suspension. Silos will be unloaded by vendor and left in a horizontal position.

C. Final location of water storage tank shall be verified onsite by Owner.

2.10 SOURCE QUALITY CONTROL

A. Section 01 00 00 - Quality control requirements.

B. Inspect and test welds as follows:

1. Examine weld joints in accordance with AWWA D100, (latest revision).
2. Comply with procedure requirements of AWWA D100, (latest revision) prior to proceeding with radiographic work.
3. Immediately notify Engineer of weld locations failing to meet standards of AWWA D100, (latest revision).
4. Repair and reinspect defective welds until acceptable.
5. Tank weld testing is not covered by the testing allowance. All weld testing shall be incidental to the cost of the tank.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify elevations and grading for tank and location of tank.

C. Refer to Section 31 22 13 for rough grading and Section 31 23 23 for backfill requirements.

3.2 INSTALLATION

A. Install tank and tank foundations in accordance with AWWA D100 and the following:

1. AWWA D100, (latest revision) - Field Painting and Disinfecting:

a. Field paint. Refer to Section 09 97 14.

b. Areas rendered inaccessible after tank erection such as the spaces between roof plates and rafters shall receive the full coating system prior to erection and/or assembly.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Testing, adjusting and balancing requirements.

B. Inspection and Testing:

1. Hydrostatic Testing:

a. Test completed and cleaned tank for liquid tightness by filling tank to its overflow elevation with water provided by Owner.

b. Correct leaks disclosed by this test.

c. Drain and legally dispose test water off site.

2. Field Welds: Tested and inspected in accordance with AWWA D100, (latest revision) - Field Inspection.

3. Concrete testing for foundation in accordance with Section 03 05 00, if applicable.

4. Independent NACE inspection of coatings in accordance with Section 09 97 14.

C. Cathodic protection system installed but not to be activated until after 11th month inspection.

3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish field representative experienced in installation of tank to supervise installation.

1. Furnish Installation Certificate attesting tank, tank foundation, and anchor bolts are properly installed and leveled.

3.5 GUARANTEE

A. The water storage tank furnished under these specifications shall be guaranteed for a period of one year from the date of final acceptance thereof against defective material, design or workmanship, which guaranty shall include a rust-free condition of the structure for the same period. In the event of failure of any part or parts during the guaranty period due to the above causes, the affected part or parts shall be replaced promptly, upon notice by the Owner, with new parts, at the site of installation, by and at the expense of the Contractor. The labor incidental to installing replacement or repair portions shall be furnished by the Contractor. The Bidder shall submit with his bid a complete and comprehensive outline of all applicable warranty information for the product they intend to use.

3.6 CLEANING

A. Section 01 00 00 - Final cleaning requirements.

B. Clean interior and exterior of tank to remove debris, construction items, and equipment.

C. Disinfect tank in accordance with Section 33 13 13.

END OF SECTION

SECTION 44 44 16

CHLORINATION EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Vacuum operated sonically regulated gas feed system with automatic switchover, capable of automatic and manual adjustment.

2. Equipment for Chlorination:

a. Gas Chlorinator System
1) Vacuum regulator with automatic switchover
2) Control unit.
3) Automatic controls.
4) Vacuum monitor.
5) Ejector.
6) Chlorine solution diffuser assembly.
7) Chlorine vent and vacuum tubing.
8) Electronic two cylinder scale.
9) Chlorine gas detector.
b. Chlorine booster pump.
c. Self-contained breathing apparatus and hard case.

B. Related Sections:

1. Section 22 11 05 - Chlorination Facility Plumbing.

2. Section 26 27 33.1 Chlorinator and Well Instrumentation and Controls.

1.2 REFERENCES

A. ASTM International:

1. ASTM D1785 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

2. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.

3. ASTM D2467 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.

4. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

5. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based for Controlled Outside Diameter.

6. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

7. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 PERFORMANCE REQUIREMENTS

A. Project operational parameters:
1. Anticipated water supply treatment requirements:
a. Design flowrate 225 GPM;
b. Target Chlorine Residual of treated water of 2 parts per million (ppm)

B. Chlorination system maximum capacity of 100 pounds per day (ppd) of chlorine, or less, depending on appurtenances (including metering tubes) installed.
1. Appurtenances (including metering tubes) sized and installed for a maximum capacity of 10 ppd.
a. Manual Adjustable feed range 1:20 of maximum capacity indicated above.
b. Automatic control feed range of 1:10
c. Capable of controlling within ±4% of the indicated feed rate via automatic control or manual adjustment.

C. Chlorination equipment supplier shall submit calculations verifying that equipment submitted is appropriate for achieving dosage for the operational parameters identified above.

1.4 SUBMITTALS

A. Section 01 00 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Submit detailed certified dimensional shop drawings for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.

2. Submit complete listing of items being provided and schematic diagram of each system. Include in schematic diagram tag marks for each item of equipment cross-referenced to chlorine system equipment list. Include specialty valves and fittings on schematic and list.

C. Product Data:

1. Submit complete information concerning materials of construction, fabrication, and protective coatings.
2. Submit calculations for verification of system sizing as indicated in Performance Requirements of this Section.

D. Test Reports:

1. Submit certified field performance test results.

E. Manufacturer's Installation Instructions:

1. Submit detailed instructions on installation requirements including storage and handling procedures, anchoring, and layout.
2. Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate equipment has been installed in accordance with manufacturer’s instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 00 00 - Execution Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the contract documents and manufacturer’s recommendations.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section.

B. Installer: Company specializing in performing work of this section.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 00 00 - Administrative Requirements: Pre-installation meeting.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspect for damage.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

D. Protect systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 00 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities, in immediate or adjacent areas.

1.11 SCHEDULING

A. Section 01 00 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule work after concrete work for support pad and prior to connecting piping work.

1.12 COORDINATION

A. Section 01 00 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation and start-up with Engineer.

1.13 WARRANTY

A. Section 01 00 00 - Execution Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 GAS CHLORINATOR SYSTEM

A. Manufacturers:

1. Regal (Chlorinators Incorporated) Model 216 Automatic Switchover System, Gas Detector, Vacuum Monitor, and Dual Cylinder Scale.
   a. Additional manufacturer requirements for specific components of the System are provided in subparagraphs that follow.
2. Substitutions: Section 01 00 00 - Product Requirements.
   a. Any substitutions are subject to NTUA approval.

B. System shall meet or exceed the Performance Requirements identified previously in this Section.

C. VACUUM REGULATOR WITH AUTOMATIC SWITCHOVER

1. Manufacturers:
   a. Regal Model 216
2. Each cylinder mounted vacuum regulator with integrated automatic switchover shall be rated for 100 pounds per day (ppd) maximum.
   a. Regulator Model Number: A 816
   b. Regulator shall be designed to reduce full supply pressure to a vacuum without venting.
   c. Built-in switchover capability shall change over to a new supply as the on-line supply is depleted.
   d. When the switchover is accomplished gas shall continue to be drawn from the former source until the container is empty.
   e. A separate switchover device will not be acceptable.
3. Provide regulators with the following:
   a. Integral self-aligning yoke.
   b. Mechanical detent to keep the standby gas supply ready for on-line service.

c. Internal pressure relief.
   1) Spring loaded, diaphragm actuated pressure relief valve.
d. Pressure relief assembly
e. Gas inlet filter.
f. Vent line connectors.
g. Vacuum line connections.
h. Off position to isolate the diaphragm and internal components from atmospheric air when the operator changes containers.
i. Reset knob to return supply indicator back to standby when gas source is replenished.
j. Selector knob and icons to indicate the chlorine gas container status.
k. Easy to read indication of stand-by, operating, empty, and off position.

D. CONTROL UNIT
1. Manufacturers:
   a. Regal 7500 Remote Meter/Rate Valve Assembly
2. Control unit shall consist of a rotameter with a V-notch rate valve.
3. Rotameter tube shall be serviceable without removing the frame from its mounting.

E. VACUUM MONITOR
1. Manufacturers:
   a. Regal VAC 2000
2. Provide dual function vacuum monitor/switch to sense low or high gas vacuum condition on chlorine gas line. Switch shall be designed for chlorine service applications.
3. Monitor shall be mounted on control panel adjacent to chlorine feeder and shall sense the vacuum level between the injector and rotameter assembly.
4. Provide three digit LED digital display of system vacuum. Unit to operate within range of 0 to 30 in Hg.
5. Include the following:
   a. Three alarm outputs.
   b. Two high or and low vacuum alarm contacts.
   c. One normally open-normally closed latching output relay.
6. Provide 1 to 100 second adjustable delay for latching alarm relay.
7. Adjustable low alarm within range of 0 to 10 in Hg. Adjustable high alarm within range of 20 to 30 in Hg.
8. Provide LED indicator for each alarm condition.
9. Enclosure: NEMA 4X.

F. EJECTOR AND CHLORINE SOLUTION DIFFUSER ASSEMBLY
1. Manufacturers:
   a. Regal (Chlorinators, Inc.): Model A-930
      1) Confirm back pressure with Engineer during submittal review.
2. Ejector
   a. Gas feeder shall have a PVC 3/4 inch fixed throat ejector rated 100 ppd to generate the operating vacuum for the system.

b. Ejector shall include built-in double check valve protection to prevent water from back flooding into the vacuum regulator.
c. Ejector shall include an integral mounting bracket, capable of mounting in either the vertical or horizontal plane.

3. Diffuser
   a. Type: Pipe insertion.
      1) Size and number of orifices in diffuser to disperse chlorine solution along entire length of diffuser to ensure adequate mixing of solution with water flowing through pipe.
   b. Diffuser assembly shall be constructed of schedule 80 PVC.
   c. Diffuser assembly shall incorporate a tru-union mounted isolation ball valve with TFE seats and Viton o-rings, as manufactured by Spears or Asahi. An additional Viton seal shall be installed between the isolation ball valve and the diffuser union to provide a water tight seal around the diffuser tube while it is being inserted or withdrawn from the process line.

G. CHLORINE VENT AND VACUUM TUBING
1. Flexible Polyethylene Tubing: Tubing, pipe and fittings shall conform to all applicable standards of The Chlorine Institute.
   a. PE tubing shall be suitable for use in Chlorine Service Piping Systems from Vacuum to 6 PSIG.
2. Supply and install tubing with diameter and ratings appropriate for the application and Performance Requirements, identified in this Section.

H. ELECTRONIC TWO CYLINDER SCALE
1. Manufacturers:
   a. Force Flow Chlor-Scale 150 Model GR150-2.

2. Scales:
   a. A quantity of two (2) chlorine scales shall be provided and shall be of the digital readout/electronic load cell type.
   b. Scale platform shall be constructed of non-corrosive PVC plastic and sized to accept 150 lb. cylinders from 10-1/4 to 10-1/2 inches diameter.
   c. Platform height shall be no more than 1-5/8 inches to allow easy handling and unloading of cylinders.
   d. Platform scale coating system shall be a minimum dry thickness of 80 mils and be resistant to moisture, chemicals, abrasion, impact, and UV light.
   e. Scale shall be of the single load cell design.
   f. Weight shall be transferred via a pivoted platform to a single stainless steel canister load cell of the electronic strain gauge type.
   g. Load cell shall be mechanically sealed with o-rings.
   h. Potted-type load cells shall not be accepted.
   i. Flexible cable shall connect the load cell to the indicator to allow easy remote installation of the readout.
   j. Cable length shall be 10 feet.
   k. Cylinder chaining bracket shall be wall mounted and use a double coil chain and a spring loaded snap hook to sure cylinder.

l. Chaining bracket shall have an integral tool rack for storing cylinder change-out tools.

3. Indicator:
   a. Indicator shall monitor 2 channels.
   b. The remote mounted LCD indicator shall carry CE marking and shall be housed in a NEMA 4X, UL approved enclosure.
   c. All operations shall be keypad operated and menu driven in order to avoid compromising the NEMA 4X seal at anytime.
   d. The alphanumeric LCD readout shall have backlighting for readability in low light conditions.
   e. Power requirement shall be 110-220 VAC.
   f. A 6 digit numerical display shall give operator the ability to monitor chemical by weight (lb or kg) or volume (gallons or liters).
   g. A bar graph display shall read 0-100% for the net contents.
   h. dual mode TARE key shall allow user to enter tare weight of the vessel or enter the net weight of the chemical depending on application needs.
   i. A diagnostics menu shall allow recalibration without the need to apply field weight tests.
   j. A user adjustable filter function shall stabilize display in the event of vibration from pumps or mixers in the immediate vicinity of the scale.
   k. Indicator shall output net weight via a 4-20 mA signal and full scale output shall be user adjustable via the keypad.
   l. Indicator shall have four adjustable set points to display low or high level conditions on the indicator.
4. Scale shall carry a full five (5) year factory warranty; “Limited” warranties shall be considered unacceptable.
5. Full scale accuracy shall be better than 1%.

I. CHLORINE GAS DETECTOR

1. Manufacturers:
   a. Regal Model 3001 Single Sensor Chlorine Gas Detector
   b. ATi series A14/A11 Chlorine Gas Detector
   c. Siemens/Wallace & Tiernan Model Acutec 35 with Auto-Test facility

2. Gas detection system shall detect presence of chlorine gas in the ambient atmosphere.
   a. Range: 0-10 ppm chlorine
   b. Power Requirements: 85-255 VAC, 50/60 Hz; 1 Amp - self-regulating.
   c. Ambient Temperature: 0 to 105 degrees F continuous; -10 to 120 degrees F intermittent.
   d. Humidity: 0-99% non-condensing.
3. Alarms:
   a. Gas detector shall have two (2) independent alarm set points for Warning Level and Alarm Level, each adjustable from 5% to 100% of range.
   b. Alarm indicators shall be High Intensity LED Bars with WARNING indicator non-latching and ALARM indicator latching function.

c. Gas detector shall have three (3) assignable alarm relays for either alarm setpoint 10A at 120 VAC, 5A at 250 VAC, resistive, SPDT configurable for normal/fail-safe, latching/non-latching, and fast/slow operation.
d. Alarm relay and indicator reset shall be activated from front panel switch or through remote set.
e. Sensor alarm shall indicate loss of sensor/transmitter input or failure of sensor Auto-Test.
f. Sensor alarm shall have front panel indicator and relay, 10A at 120 VAC, 5A at 250 VAC, resistive SPDT factory set to fail-safe operation.
g. Gas detector shall have an integral audible alarm horn with a weatherproof 12 VDC piezoelectric horn 85-dB output signal for local alarming.
h. Gas detector shall be equipped with a power failure alarm relay for loss of AC input power, 10A at 120 VAC, 5A at 250 VAC, SPDT resistive.

4. Sensor/Transmitter:
   a. Sensor shall be electrochemical gas diffusion type.
   b. Sensor shall be fitted with an integral gas generator that automatically tests the sensor daily with an electrochemically produced gas sample.
   c. Sensor/transmitter shall be in a remotely mounted NEMA 4X enclosure.
   d. Gas sensor shall be capable of being remotely mounted up to 1,000 feet to receiver.
   e. 25 feet of two wire cable shall be provided.
   f. Sensor operating life shall be 2 years.
   g. Sensor storage life shall be 1 year.
5. Monitor Concentration:
   a. Display shall be 4 digit LED, sunlight readable.
   b. Output signal shall be isolated 4-20 mA DC, 1000 ohms maximum load.
6. Enclosure:
   a. NEMA 4X polystyrene with knockouts on four sides for 1/2-inch FNPT conduit hubs.
   b. Four conduit hubs shall be provided.
   c. Enclosure shall have universal mounting brackets for wall mounting.
   d. Enclosure shall have a clear, hinged polycarbonate window with push-button latches to provide easy access to the control modules.
7. Chlorine gas detector battery back-up:
   a. A battery back-up compatible with the electrical requirements of the chlorine gas detector assembly shall be furnished by the manufacturer of the chlorine gas detector assembly.

2.2 CHLORINE BOOSTER PUMP

1. As specified on Drawings.

2.3 SELF-CONTAINED BREATHING APPARATUS AND HARD CASE

A. Manufacturers:

1. Self-contained breathing apparatus:
   a. Survivair Cougar Model #6888888.
   b. SCOTT industrial SCBA Model IND112AA3104121

2. SCBA hard case:
   a. MSA Model # 983867.
   b. Allegro 4235 SCBA Cabinet
3. Substitutions: Section 01 00 00 - Product Requirements.

B. Self-contained Breathing Apparatus:

1. Open-circuit, positive pressure self-contained breathing apparatus suitable for use in chlorine gas atmosphere.
2. Certified by NIOSH to provide a nominal service time of 30 minutes.
3. Low-pressure (2216 psig) aluminum air cylinder containing 30 minute air supply.
4. NIOSH-approved facepiece.
5. First stage regulator.
6. Second stage regulator.

3.1 EXAMINATION

A. Section 01 00 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify layout and orientation of equipment, accessories and piping connections.

3.2 INSTALLATION

A. Install equipment and accessories as indicated on Drawings.

B. Install chlorine vent and vacuum tubing in Schedule 80 PVC pipe to location outside of building wall. Install turned down elbow and terminate with fine mesh insect screen.

C. Cleaning:

1. Clean portions of chlorine system to remove cutting oil, grease and other foreign materials; do not use hydrocarbons or alcohols, for cleaning residuals from these materials.
2. Before use, dismantle and clean new valves or other equipment received in oily condition. Test valves with clean dry air at 150 psi for seat tightness before installation.
3. Dry chlorine piping before use. Use steam and dry air. When steam and dry air are not available purge completed system with dry cylinder air or nitrogen to remove moisture.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Preliminary Leakage Testing:

1. With the exception of components design to operate under vacuum, pressurize chlorine system with nitrogen to at least 150 psig. With system under pressure,

test each joint and connection for leaks by application of soapy water to each joint and connection.

2. Vacuum test components designed to operate under vacuum to locate and correct any air leaks. Do not subject these components to positive pressure.

C. Final Leakage Testing: Test automatic chlorinators first to ensure chlorinators are operational. Use chlorinators to evacuate system in event leaks are found. Perform in the following sequence:

1. Check unions and pipe connections in chlorine system for tightness.

2. Open header and auxiliary valves one turn.

3. Soak rag with strong ammonia water (commercial 26 Be) and swab each joint and connection.

4. Momentarily open one chlorine cylinder valve to pressurize system to approximately 10 psig then shut off tight; observe chlorine leaks evident by formation of dense white smoke.

5. When leaks are found, turn on automatic chlorinators to evacuate system, then repair leaks; retest joints and connections after repairs are made.

D. Performance Testing: Test each piece of chlorination equipment under design conditions for two to four hours to demonstrate proper functioning and automatic regulation of system; test alarms and signal generation; exercise equipment control and manual override where applicable; demonstrate equipment safety features.

E. Equipment Acceptance: Adjust, repair, modify or replace components failing to perform as specified and rerun tests; make final adjustments to equipment under direction of manufacturer's representative.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 00 00 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish services of manufacturer's representative experienced in installation of products supplied under this specification for one half day at project site for installation inspection and field testing, and instructing Owner's personnel in maintenance of equipment.

C. Furnish Installation Certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.5 SPARE PARTS

A. Contractor shall supply the following spare parts to NTUA, at a location to be specified by NTUA within 75 miles of the project site:

1. Two (2) SCBA units with hard cases

2. Four (4) Preventative Maintenance (PM) Kits – Vacuum regulators

3. Two (2) PM Kits –Ejectors

4. Two (2) PM Kits - Rotameter

5. Two (2) Orifice V-notch Teflon

6. 50 LF 3/8” OD PE tubing

END OF SECTION